HYDROGEOLOGIC CHARACTERIZATION REPORT

Murphy's Waste Oil Service, Inc.
252 Salem Street
Woburn, MA 01801

(Volume 1 of 2)

Prepared For:

Murphy's Waste Oil Service, Inc.
252 Salem Street
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Clean Harbors Environmental Services, Inc. (CHES) has prepared this Hydrogeologic Characterization Report of the property located at 252 Salem Street and 252 Rear Salem Street in Woburn, Massachusetts (the site). The site is owned by Old Oil Realty Trust and is leased by Murphy's Waste Oil Service, Inc. (Murphy's), a transfer, storage and disposal facility (TSDF) for waste oil and solvent-contaminated oil.

This Report was prepared to satisfy requirements stipulated in a RCRA Part B Permit issued by the Massachusetts Department of Environmental Protection (DEP) to Murphy's effective October 19, 1993. Section 10 of the Part B Permit requires a hydrogeologic characterization of the site and site area. Background information is presented below which briefly describes the site, site area use and history, followed by a hydrogeologic characterization based on existing information. Recommendations are made at the close of this Report to collect additional information necessary to satisfy the requirements detailed in the Part B Permit.

BACKGROUND

Site Description

The site is located at 252 Salem Street and 252 Rear Salem Street in the eastern portion of the City of Woburn, Massachusetts. The general location of the site is shown on Figure 1. The site is located approximately 2,000 feet west of and upgradient from the Aberjona River. The site consists of one parcel of land zoned as industrial and has a total area of approximately 3.4 acres. The City of Woburn Assessor's Office designates the site as Parcel 41, Block 005 on Map 16. The operating portion of the site is surrounded by a chain-link fence which restricts access to the site. Vehicular access to the site is via Salem Street. Figure 2 is a Plot Plan illustrating site details.

Throughout most of its history, the site has been used primarily as a waste oil and/or virgin oil temporary storage facility. In the 1920s, the Woburn Oil Company reportedly began operations

by storing virgin oils on the northern portion of the site. Waste oils were additionally accepted onto the site in the mid-1950s. Murphy's Waste Oil Service, Inc. acquired the site facility on July 7, 1977. As many as 20 aboveground storage tanks installed by Murphy's Waste Oil Service, Inc. were located on the site in 1986. The current owner of the site land is Old Oil Realty Trust, to whom the land was deeded in 1980. In February 1989, Clean Harbors of Kingston, Inc. purchased the stock (i.e., the facility and assets) of Murphy's Waste Oil Service, Inc. and has continued to operate the facility under the latter name and leases the site from Old Oil Realty Trust.

The site is described in three sections, the Northern, Central and Southern Sections. The Northern Section is not paved and is referred to by previous site occupants and on site plans (dated in the 1920s) as the "Oil Yard". A gravel parking area is currently located in the Northern Section of the site. A two-foot high concrete dike, which was constructed in September 1986, is also located in the Northern Section of the site. The dike surrounded seven aboveground oil storage tanks, which were subsequently relocated to another area of the site in 1990.

A City of Woburn sanitary sewer easement traverses the Northern Section of the site in an east-west orientation. The sewer which occupies the easement originates at the westerly abutting property, the former John J. Riley Tannery, and discharges into a main line of the City of Woburn sanitary sewer system. Site representatives indicated that wastewater in the sewer historically overflowed when the tannery was still in operation, however, .the volume of wastewater that overflowed on the site could not be determined.

The Central Section of the site is occupied by a waste oil facility which contains eleven aboveground storage tanks, offices, a laboratory and rest rooms. The facility was constructed between March 1989 and January 1990. The tanks in the facility are placed within a concrete containment area which is surrounded by a concrete dike and covered with a canopy. The area surrounding the facility is surfaced with crushed gravel, as is most of the Central Section of the site. Underground utilities which service the oil storage facility include City water and sewer.

A garage is located in the Southern Section of the site. The garage is constructed of steel siding over a four-foot concrete foundation. The floor is also constructed of concrete and reportedly does not contain any floor drains. From 1979 to the Summer of 1987, Murphy's Waste Oil Service, Inc. used the garage as an office and for company truck maintenance. This building is

served by an on-site septic system. According to Mr. Francis Ryan of the Woburn Board of Health,.no problems associated with the septic system associated with this building were reported

The garage is heated by oil which is stored in a 1,000-gallon underground storage tank located off the southeast corner of the building. No information was available in Fire Department and City Clerk records reviewed indicating the installation date. The property owner has a copy of the permit for this tank which was issued in 1979. The areas west and south of the garage are well-maintained and vegetated with grass.

Topographically, the ground surface in the Southern Section of the site slopes down gently to the north from Salem Street. The ground surface is relatively level within the fenced area of the Central and Northern Sections of the site (50 feet National Geodetic Vertical Datum) . Properties on Salem Street adjacent to the site are located on high ground, and a steep embankment approximately 30 feet high slopes down to the north outside of the fence. A low wetlands area is located outside of the fenced area in the eastern portions of the Central and Northern Sections of the site. Figure 3 is a Surface Contour Plan of the site which was developed based on a stadia survey of the site tied into a benchmark along the Aberjona River.

HISTORY OF PETROLEUM USE AND SPILLS AT THE SITE

Petroleum Use on the Site

The site has a history of oil storage dating back to the 1920s. Figure 4 shows the current and former locations of storage tanks and tank farms on the site dating back to the 1960s. The waste oil facility on the Central Section of the site currently contains eight aboveground waste oil storage tanks with a total capacity of 120,000 gallons and a 1,500-gallon aboveground receiving tank. A 3,000-gallon aboveground diesel tank and a 2,000-gallon aboveground heating oil tank are also located on the site for facility operations. A 1,000-gallon underground heating oil tank is also located off the southeast corner of the garage (as discussed previously).

A partially-buried 275-gallon waste oil tank was formerly located approximately 50 feet north of the garage. This tank was used by the former Murphy's Waste Oil Service, Inc. for community residents to dispose waste automotive oils. This tank was removed from the site in March 1988.

Twenty storage tanks were formerly located in the Northern Section of the site in the 1980s. Seven of the tanks were located within the diked area and 13 tanks were located around and south of the diked area. The 13 tanks outside the dike were removed from the site in March of 1988. Six of the seven tanks in the diked area were relocated to the new facility in the Central Section of the site and one tank was decommissioned and removed from the site in 1990.

The site has a history of oil use on the ground surface dating back at least to the 1920s. A portion of the site, presumably in the Central Section, was used as a waste oil pit in the 1950s. The time of use, dimensions and location of the oil pit are not known. Additionally, up until the late 1970s, oil was used on the dirt roadways on the site as a dust control measure, as allowed by state regulations.

Petroleum Releases on the Site

There are several reported accidental releases of petroleum that occurred on the site in the 1980s. The spill information has been compiled from review of the City of Woburn Fire Department records and interviews with Chief Robert Doherty of the Fire Prevention Office; Ms. Rodene DeRice; Mr. Kingsley Ndi and Mr. Robert Cleary of the DEP; Ms. Barbara Newman of the US-EPA; and Ms. Joan Murphy, Trustee of Old Oil Realty Trust.

Diesel Fuel Spill - Central Section. On December 17, 1987, an estimated 100 to 150 gallons of diesel fuel was released to the surface soils from a North Suburban Transportation Company diesel fuel delivery truck. The spill was located on the north-central portion of the site, between the Central and Northern Sections. Apparently, the diesel fuel release occurred during fueling of the school buses operated by the North Suburban Transportation Company, which were parked on the central portion of the site during this time period. Several puddles of separate-phase product were observed in the area of the spill. Cleanup measures undertaken by representatives of the North Suburban Transportation Company consisted of applying Speedi-Dri to the spill area and utilizing a "shop-vac" to retrieve the spilled product. On December 18, 1987, 15 to 20 cubic yards of stone were applied to the site in the area of the spill, covering an area of approximately 50 feet by 75 feet.

Waste Oil Use as Dust Control Measures. As evidenced in a 1966 aerial photograph, waste oils were applied to site soils in an effort to control dust on the site. Oil covered the area near the former tank farm on the Northern Section and also the right-of-way through the site from the Northern Section to Salem Street. The oil also extended to the land east of the former tank farm on the site.

This practice of using oil to control dust was common prior to the 1980s for most waste oil facilities. In fact, in 1978, the DEP - Division of Water Pollution Control implemented a policy limiting land spreading of waste oils to the period from May 15 to October 15. In the early 1980s, the DEP - Division of Solid and Hazardous Waste was formed and, under it's jurisdiction, this practice of oil deposition on land was prohibited. Ms. Joan Murphy reported that this use of oil by Murphy's Waste Oil Service, Inc. did not occur since 1979.

Fuel Oil Release, December 7, 1993. On December 7, 1993, approximately 75 gallons of reclaimed oil were released to an unpaved gravel area off the northeast portion of the facility. Because the ground surface was frozen, the oil pooled on the ground and had minimal penetration to the soils. The oil was encircled with Speedi-Dri, and 50 gallons of product were recovered immediately with a vacuum truck. Speedi-Dri and 3M oil absorbent pads were then used to clean the residual oil on the ground surface. Four 55-gallon drums of 3M pads and Speedi-Dri were generated and properly disposed during this activity.

On December 10, 1993, two cubic yards of soil impacted by the release were excavated from the release point using a front-end loader and placed in flex bins. Four samples were collected from the excavated area and a fifth sample was also collected away from the area as a background sample. The samples were analyzed for petroleum hydrocarbons, and the results indicated that an elevated level of petroleum hydrocarbons was present in the vicinity of one of the samples. An additional cubic yard of soil was subsequently removed from this area and the area resampled. The results were similar to the background sample collected previously.

A Response Action Outcome (RAO) statement was prepared relative to this spill and was submitted to the DEP in January of 1994. The RAO concluded that no further action was required relative to this incident.

SITE AREA GEOLOGY AND HYDROGEOLOGY

A Massachusetts Geographic Information System (GIS) map centered around the Murphy's site is presented in Appendix A. The map indicates the environmental and water use setting in the site area, and illustrates the site position relative to sensitive environmental receptors. Based on the information presented on the map, the site is located in a potentially productive high yield aquifer, an interim wellhead protection area and within the zone of contribution of a public water supply located near Walnut Hill (located less than 0.5 miles northeast of the site).

The site is located in the southwest corner of the study area known as the Wells G & H site, and the site is located approximately 2,000 feet southwest of the Municipal Wells G&H. The Wells G&H study area was listed as a Superfund site in 1982 and is currently under investigation by the PRPs. Chlorinated organic compounds were detected in Wells G&H in 1979. The wells were shut down and the USEPA tasked a variety of contractors to conduct hydrogeologic investigations and groundwater quality evaluations in a 10 square-mile portion of East and North Woburn. Figure 5 is a Facility Surrounding Area map which illustrates the site location relative to Wells G&H and two other nearby private production wells (no longer in use) which are discussed below.

During the 1980s, the geologic setting of the Wells G&H area was determined by various consultants and government agencies. The description of the regional geology and hydrogeology presented below is based on information presented in the Wells G&H studies and is supplemented, where applicable, by actual site information. Much of the regional information presented below was obtained from a 1986 report prepared by NUS Corporation entitled *Wells G&H Site Remedial Investigation Report, Part I, Woburn, Massachusetts*, and a 1987 report prepared by the Unites States Geological Survey (USGS) entitled *Area of Influence and Zone of Contribution to Superfund-Site Wells G and H, Woburn, Massachusetts.*

Surficial Geology

The Wells G&H study area is located in a north-south trending buried glacial valley, through which the Aberjona River flows. The unconsolidated deposits within most of the valley are comprised of glacial deposits consisting of a complex mixture of gravel, sand, silt and clay. These deposits were laid down during deglaciation of the area 14,000 years ago. More recent alluvial deposits associated with the Aberjona River overlie the glacial deposits at the lower elevations in the valley. The total thickness of the central valley sediments is estimated to be approximately 135 feet.

The glacial deposits in the study area are of two major origins based on their methods of deposition. The two deposits are a stratified drift unit and an ice contact unit. The stratified drift unit is located in the central portion of the buried valley, and the ice contact units are located on the eastern and western sides of the valley.

The stratified drift deposit is comprised of stratified gravel, sand, silt and clay ranging from five feet to 50 feet in thickness. In general, the sediment grain size decreases with depth to medium to fine sand and silt at the bottom of the unit A sand and gravel unit underlies the fine material at a depth of approximately 70 feet to 80 feet. An interbedded blue to gray very fine sand, silt and clay was present in the lower unit along the western portion of the study area and was thickest in the deepest portion of the valley.

The deposits at the higher elevations on the eastern and western sides of the valley are poorly sorted and represent ablation till/ice contact sediments deposited as the underlying glacial ice melted. Within the till are lenses of sorted sand and gravel which represent localized areas of meltwater deposits.

At several locations within the study area is a basal till between the bedrock and the stratified drift and the ablation units. The basal till is a dense layer of sediments deposited at the bedrock/glacier interface.

Based on the approximate mapping of the surficial deposits in the Wells G&H study area, the northern portion of the Murphy's site appears to be underlain by stratified drift deposits and the southern portion of the site appears to be underlain by ice contact sediments. The soils

encountered during the soil boring program on the site in the late 1980s (discussed below) consisted of an average of 6.5 feet of fill material underlain by stratified sand and gravel with lesser amounts of silt and clay to a maximum penetration depth of 30 feet. These observations appear to be consistent with stratified drift deposits mapped in the study area. The depth to groundwater in the vicinity of the site was observed to be approximately eight feet below the ground surface during the late 1980s on-site investigations.

Bedrock Geology

The Wells G&H study area is situated within the Appalachian Mountain orogenic belt and consists of a diorite and gabbro complex with secondary metavolcanic rocks and intrusive granite and granodiorite. The units have been severely distorted by faults and fracturing. Weathering associated with the faulted materials appears to have produced bedrock troughs in the study area. These weathered troughs provided a preferential pathway for glacial masses along with preferential plucking of the less resistant rock, which resulted in the widening and deepening of the valley immediately surrounding the fault. These mechanisms are believed to have produced the bedrock valley through in which the Aberjona River is located.

There are two major rock types in the Wells G&H area; the Dedham Granodiorite and the Salem Gabbrodiorite. The Dedham Granodiorite is believed to be the older of the two rock types and dates to the Precambrian. It is a grayish-pink, coarse grained, moderately foliated, biotite-hornblende quartz feldspar granodiorite. Based on rock quality designation values published for the rock, it is slightly to moderately fractured.

The Salem Gabbrodiorite is Precambrian to Ordovician in age, and is a medium to coarse-grained, blueish gray rock composed of hornblende, quartz and feldspar. The rock is highly fractured and contains quartz veins throughout.

The axis of the bedrock valley slopes from north to south and corresponds to the current course of the Aberjona River. From the axis point, the bedrock rises to the east and west with steepening gradients toward the trough edges. These bedrock contours generate the characteristic U-shape associated with glacially-scoured bedrock valleys.

The shape of the valley also corresponds to the type of rock in the study area and the effects of glacial erosion on rocks of different resistance. The rock in the deeper portions of the valley is the Salem Gabbrodiorite. Because this rock is more heavily fractured, it was apparently less resistant and more easily excavated and plucked by glacial erosion. The more resistant Dedham Granodiorite underlies the higher elevations on the sides of the valley. The preferential glacial erosion is common in glacially-carved valleys.

During soil boring activities on the Murphy's site in the late 1980s, the deepest penetration of the overburden deposits was 30 feet. Therefore, bedrock was not encountered. However, based on the mapping of the bedrock in the Wells G&H study area, the western portion of the site appears to be underlain by Dedham Granodiorite, while the eastern portion may be underlain by the Salem Gabbrodiorite. The exact location of the boundary between the two rock types cannot be determined with the available geologic data published to date. The depth to bedrock beneath the site is estimated to be 135 feet below grade.

Hydrogeology

The site area is situated within the Aberjona River Valley which generally traverses the eastern portion of Woburn, Massachusetts in a north-south orientation. The Aberjona River, located approximately 800 feet northeast of the site, flows in a southerly direction through the site area. The river discharges into the Upper Mystic Lake, located three miles south of the Murphy's site, in Winchester, Massachusetts. Surface configurations of the Aberjona River Valley generally include the Aberjona River (along the general center of the valley), associated flood plain, and the valley walls. The valley walls of the Aberjona River Valley are located on either side of the river (approximately 2,000 feet and 1,000 feet east and west of the river, respectively). The Murphy's site is situated along the western portion of the river basin, near the western valley wall.

Two primary sources of recharge to the stratified drift aquifer underlying the site area are infiltration of precipitation and surface/groundwater recharge from the bedrock highlands flanking the valley. A third source is the Aberjona River. The site area has an average annual precipitation of 44 inches. Of this total, approximately 20 inches is removed by surface runoff

and the remaining 24 inches either infiltrates to become groundwater or is subject to evapotranspiration.

The estimated transmissivity of the stratified drift deposits which include the Wells G&H aquifer is in excess of 4,000 ft^2/day. The USGS estimated transmissivities near wells G and H at 29,700 ft^2/day and 20,700 ft^2/day, respectively. The average horizontal hydraulic conductivities at wells G&H are 350 ft/day and 235 ft/day, respectively. The other glacial till and fluvial deposits underlying the study area have a more moderate permeability. The bedrock in the site area is sufficiently fractured to support modest to moderate groundwater yields.

Historical water table measurements in the study area indicate annual water level variations of up to five feet, with the higher levels occurring between November and April and the lower levels occurring in August and September. The groundwater table has been determined to be 10 feet to 15 feet below the ground surface in hilly areas on the eastern and western flanks of the valley and at or near the surface in most of the low-lying areas. While the depth to groundwater on the site has been estimated to be approximately eight feet below the ground, no detailed groundwater mapping has yet been performed on the site.

Under natural gradients and without the pumping of nearby production wells, groundwater flow in the study area is toward the Aberjona River. Areas west of the river, including the Murphy's site, have a southeasterly groundwater flow direction with an average horizontal gradient of 0.5 percent. Areas east of the river have a southwesterly groundwater flow direction with an average horizontal gradient of 2 percent.

Upward and downward vertical gradients were measured on the west side of the river. Vertical gradients on the eastern side of the river were greater than those on the western side and were consistently downward in direction. The wetlands immediately east of the river, however, showed upward gradients at greater values than those measured in the wetlands on the western side.

Two private production wells are located north and west of the site which belonged to the John J. Riley Tannery. These wells are referred to as John J. Riley Tannery Production Wells No. 1 (located approximately 50 feet west of the site) and No. 2 (located approximately 550 feet north of the site), and their locations are shown on Figure 5. Neither well is still in use. John J. Riley

Tannery Production Well No. 1 reportedly produced an estimated 300,000 gallons of water per day. At this rate, groundwater flow patterns on the site were most likely affected while this well was productive. When both production Wells No. 1 and 2 were simultaneously operating, it is likely that groundwater flow beneath the Murphy's site may have been altered to flow in a north to northwesterly direction. In the mid 1980s, USEPA data indicated that groundwater south of these production wells (including the Murphy's site) was flowing in a north-northeasterly direction toward the production Well No. 2. This situation would have made the easterly abutting property (formerly occupied by the Whitney Barrel Company) hydrologically upgradient. The John J. Riley Tannery closed down in 1991. Because the two production wells are no longer in use, the natural groundwater flow direction to the southeast is expected to prevail at the site.

As previously discussed, the bedrock underlying the site area consists of crystalline igneous rock. The only ability a rock of this type has to transmit water is through fractures, and the transmission is dependent upon the extent of fractures, including size, orientation and degree of interconnection of the fractures. There are many bedrock wells set in fractures in the Aberjona River Valley. One such well, located 750 feet east of Well G, has a reported yield of 45 gpm. A second bedrock well, located approximately 2,000 feet east of Well H, has a reported yield of 110 gpm. The bedrock beneath the site area appears to be adequately fractured to support modest to moderate groundwater yields. The fracturing detected in the upper bedrock (during NUS and USGS investigations) suggests that recharge to the bedrock aquifer is derived in part from the overlying glacial deposits.

SITE INVESTIGATIONS

During the mid to late 1980s, Murphy's was preparing to construct the new tank facility currently in the Central Section of the site. Two separate structural soil boring programs were completed. The first boring program was completed in the Northern Section of the site (the original location of the proposed facility) in December 1987 and February 1988 and included 17 soil borings, one of which was completed as a groundwater monitoring well. When it was determined that the proposed facility footprint extended off the western site boundary, the proposed location was changed to the Central Section of the site, and a second program of twelve additional structural soil borings was performed in July of 1988.

Petroleum contamination was encountered in the Central Section of the site during the second soil boring program. The DEP (then the DEQE) was informed of the contamination encountered at that time. Based on the identification of contamination in the site soils, a preliminary environmental subsurface exploration program on the Central Section of the site was initiated. The main objective of this phase of study was to delineate the extent of petroleum contamination in this area so that a remediation and construction plan could be developed. This investigation was performed in January and February of 1989 and consisted of eight additional soil borings, which were completed as groundwater monitoring wells. Figure 6 shows the locations of all soil borings and monitoring wells installed during the structural and environmental investigations performed at the site. Logs for all soil borings are included in Appendix B.

A sequential description is presented below of the structural and environmental investigations performed at the site. Soil types and quality will be discussed in each investigation to develop the initial characterization of the contamination detected on the site.

Structural Boring Program - Northern Section

The first structural soil boring program on the Northern Section of the site consisted of performing test borings in the vicinity of the former tank farm dike. The test borings were completed in December 1987 (inside the concrete dike) and February 1988 (around the tank farm dike). The borings are identified by the prefix CHI- followed by a boring identification number and the year in which it was performed (1987 or 1988).

General Subsurface Conditions. The general subsurface profile in the vicinity of the dike area consisted of a five-foot layer of brown, coarse-grained sand above a one-foot layer of rusty/brown to black (petroleum stained) silt. The silt was underlain by a tan, medium-to coarse-grained sand deposit. The sand deposit was encountered approximately seven feet below the ground surface to the maximum boring depth (eight to ten feet below the ground surface).

December, 1987 Drilling Activities. On December 17 and 21, 1987, a total of nine soil borings were performed within the concrete diked area in the Northern Section of the site. These soil borings were performed utilizing a portable tripod drilling rig equipped with three-inch casing which was driven into the ground by a 140-pound hammer. During the boring process, split-spoon samples were collected at two-foot intervals from the ground surface to approximately 8 to 10 feet below the ground surface. The soil borings completed in the first structural boring program are identified by CHI - "#"/87.

The soil samples were screened for the presence of volatile organic compounds (VOCs) using a portable photoionization detector (an HNU meter) and headspace methodology. Generally, the HNU meter measures total VOCs present in the headspace of a sample. The total VOC concentrations detected are reported in parts per million (ppm); individual organic compounds are not discriminated by the HNU meter. The HNU screening data are presented on the respective soil boring logs in Appendix B.

The total VOC content detected in the soil samples collected from boring CHI-5/87 was the highest of all the samples screened using the HNU meter. Test boring CHI-5/87 was located near the southwestern portion of the concrete dike. The VOC concentrations for CHI-5/87 soil samples generally increased with depth and ranged from 5 ppm in the surface sample to 750 ppm at a depth of 6 to 8 feet (near the groundwater table).

Elevated total VOC levels were detected in the soil samples collected from borings CHI-4/87 and CHI-8/87. The elevated levels in the soil samples collected from borings CHI-4/87 and CHI-8/87 were respectively: 30 ppm and 160 ppm (surface sample); 5.2 ppm and 66 ppm (4 to 6 feet); and 50 ppm and 4.4 ppm (6 to 8 feet). The concentrations in the soil samples from the remaining borings were at or below 10 ppm total VOCs. As illustrated on Figure 6, borings CHI-4/87, CHI-5/87 and CHI-8/87 were situated along the southwestern portion of the concrete dike. The elevated HNU readings detected in these borings may be indicative of residual contamination associated with a surficial oil release. However, because the deeper samples were collected at the water table, some the the headspace results may also be indicative of VOCs in the groundwater.

Significant petroleum odors and slight petroleum staining accompanied the elevated HNU readings in the borings identified as CHI-4/87, CHI-5/87 and CHI-8/87. The odor detected in

CHI-4/87 soils was encountered near the ground surface. A stronger petroleum odor was encountered in CHI-5/87 at depths between 3 feet and 6 feet below the ground surface.

February, 1988 Drilling Activities. On February 17, 1988, eight additional structural test borings were performed west of the dike area. Soil boring CHI-6/88 was completed as a groundwater monitoring well. Approximate locations of the eight borings (which includes the one monitoring well) are illustrated on Figure 6. These soil borings were performed using a truck-mounted drilling rig equipped with hollow-stem augers. During the boring process, split-spoon samples were obtained at two-foot intervals from the ground surface to the depth at which groundwater was encountered. No VOC screening was performed on the soil samples which were collected for laboratory analysis. Each boring of this section is identified by CHI-"#"/88.

Petroleum odors were noted in four of the eight borings. The petroleum odors were primarily noted in surface soils collected from borings CHI-2/88, CHI-3/88, CHI-4/88 and CHI-6/88. Significant oil staining was noted on the sampling equipment during drilling of CHI-6/88 and the boring was, therefore, completed as a monitoring well. The four test borings with notable petroleum odors were generally located directly northwest of the diked area. Additional information regarding soil and groundwater analytical data for this well is addressed below.

Laboratory Results of Soil Boring Samples. All soil samples obtained from the structural borings in the Northern Section of the site were collected at two-foot intervals. The soil samples were properly stored and submitted to Clean Harbors Analytical Services, Inc. (now known as CHES) the same day they were collected. All samples were then laboratory-composited and analyzed for pH, VOCs (by EPA Method 8240), polychlorinated biphenyl (PCB) compounds, petroleum hydrocarbon oil and grease (by infrared spectroscopy), 13 priority pollutant total metals (plus barium and hexavalent chromium), sulfide and total cyanide. The analytical parameters sulfide, cyanide and pH were selected based on the proximity of the site to a working tannery (hydrogen sulfide odors were noted during the drilling activities). Semi-volatile base/neutral and acid (BNA) extractable organic compounds and Extraction Procedure (E.P.) Toxicity tests for eight priority pollutant metals were additionally performed on some of these samples. The laboratory reports of analysis and the Chain-of-Custody records are included in Appendix C, and the analytical results are summarized in Tables 1 through 4.

The concentrations of sulfide in soils were relatively low and ranged from 2.9 milligrams per kilogram (mg/kg) to 32 mg/kg. Cyanide was not detected in any of the soil boring samples and the pH values measured (from 5.2 to 7.2) were within the normal range.

Volatile organic compounds associated with petroleum were detected in only one of the 17 test borings completed in the Northern Section of the site (boring CHI-6/88). A concentration of 580 micrograms per kilogram (ug/kg) of total xylenes was detected in the sample collected from CHI-6/88 (0-2 feet). No other VOCs were detected in the sample. The presence of xylenes without benzene, toluene and ethylbenzene may be indicative of a weathered or aged petroleum product. Visual oil saturation was noted during drilling of this boring and the laboratory analysis also detected an elevated level of oil and grease in the composite soil sample (16,000 ppm petroleum hydrocarbon oil and grease).

Chlorinated VOCs, including 1,1-dichloroethane, 1,1,1-trichloroethane, trichloroethene and tetrachloroethene, were detected in low concentrations in soil samples collected from boring CHI-9/87 (completed within the diked area) and in all but three of the soil borings completed around the dike area. Chlorinated compounds are typically found in the dry cleaning, textile processing and metal degreasing industries.

BNA analyses were performed on the soil composite samples collected from the eight borings outside the diked area and boring CHI-5/87 inside the dike (which was selected based on elevated HNU data). The laboratory results for sample CHI-5/87 and samples CHI-2/88 through CHI-8/88 indicated that no BNA compounds were detected. A concentration of 2,500 mg/kg bis (2-ethylhexyl) phthalate was detected in the soil sample collected from boring CHI-1/88 (depth of 2-4 feet, located in the northeast corner of the concrete dike). This compound is commonly found in plastic materials, and was detected in a number of groundwater samples from locations throughout the Wells G&H study area. Bis (2-ethylhexyl) phthalate is utilized as a plasticizer in the chemical industry and is fairly ubiquitous in urban environments. It is also a common contaminant of environmental samples introduced during sample collection or laboratory analysis through the use of plastic disposable gloves.

The levels of petroleum hydrocarbon oil and grease found in the soil samples were considered high. The highest concentration of petroleum hydrocarbon oil and grease was found in the

composite sample from boring CHI-6/88 (16,000 mg/kg). This data coincides with the evidence of oil saturation in soils encountered during drilling. In soil borings CHI-4/87, CHI-5/87, CHI-2/88 and CHI-3/88 (the western portion of the Northern Section), petroleum hydrocarbon oil and grease concentrations ranged from 3,500 mg/kg to 7,900 mg/kg. Concentrations ranging between 1,100 mg/kg and 2,600 mg/kg were detected in soil samples collected from CHI-2/87, CHI-8/87, CHI-6/87 and CHI-4/88. The concentrations of petroleum hydrocarbon oil and grease in the remaining soil borings ranged between 930 mg/kg and 120 mg/kg. Analysis of the soil sample collected from boring CHI-7/88 (depth of 0-2 feet, located outside of the fence) indicated a concentration of only 22 mg/kg.

PCBs were detected in soil samples from borings CHI-6/87 and CHI-7/87 at concentrations of 0.21 mg/kg and 0.11 mg/kg, respectively. PCBs detected outside the diked area in borings CHI-1/88, CHI-3/88 and CHI-6/88 ranged in concentration from 0.5 mg/kg to 0.6 mg/kg. The EPA policy for PCBs allow up to 25 mg/kg PCBs in soils on sites with restricted access. In all instances, the detected levels of PCBs were below the EPA allowable levels.

Analyses of the 13 priority pollutant total metals (plus barium and hexavalent chromium) were performed on the composite soil samples collected from each boring. The results are presented in Tables 3 and 4. The measured concentrations of some of the metals (cadmium, lead, mercury, and selenium) were considered to be elevated compared to published values for natural soils (*A Compendium of Superfund Field Operations Methods, USEPA/540/P-87/001*). The maximum observed cadmium concentration (2.9 mg/kg in CHI-5/87) significantly exceeded the published average value for cadmium (0.06 mg/kg). Similarly, lead (maximum 400 mg/kg), mercury (maximum 0.44 mg/kg), and selenium (maximum 1.9 mg/kg) exceeded the published average values of 10 mg/kg, 0.03 mg/kg, 0.3 mg/kg, respectively. Hexavalent chromium was also detected in composite soil samples from three of the borings (CHI-1/88, CHI-7/88 and CHI-8/88 at concentrations up to 1.5 mg/kg, which is considered to be elevated.

Soil samples from borings CHI-1/87 through CHI-5/87 and CHI-6/87 through CHI-9/87 were composited into two respective samples for laboratory analysis of E.P. Toxicity 8 priority pollutant metals. An E.P. Toxicity analysis determines whether the metals present in the soils would leach under acidic conditions (conditions similar to acid rain). The laboratory data indicate that no E.P. Toxicity metals were detected above the laboratory method detection levels during this analysis.

Soil samples from borings CHI-1/88 through CHI-4/88 and CHI-5/88 through CHI-8/88 were also composited into two respective samples for laboratory analysis of E.P. Toxicity 8 priority pollutant metals. The laboratory data for these samples indicate that a low concentration of 0.01 mg/kg silver was detected in both composite samples; none of the other tested metals were detected during this analysis.

Summary of Soil Analytical Results. Soil samples collected from test borings CHI-4/87, CHI-5/87, CHI-2/88, CHI-3/88, CHI-4/88 and CHI-6/88 were identified as having the most elevated levels of the parameters tested. The area defined by these borings was located on the western portion of the Northern Section of the site, extending east from the western site boundary to slightly east of the western concrete dike wall. Of these borings, concentrations detected in soil boring CHI-6/88 were the highest, with elevated levels of xylenes (580 ug/kg) and petroleum hydrocarbon oil and grease (16,000 mg/kg). A low concentration of 0.6 mg/kg PCB compounds was also detected in the CHI-6/88 soil sample.

Analyses of oil samples collected from the other borings in this same group (CHI-4/87, CHI-5/87, CHI-2/88, CHI-3/88 and CHI-4/88) detected elevated levels of petroleum hydrocarbon oil and grease at concentrations ranging from 2,600 mg/kg to 7,900 mg/kg. Chlorinated compounds were also detected in the soil samples collected from borings CHI-2/88 and CHI-3/88. The sample from CHI-3/88 also contained an elevated concentration of PCBs (0.5 mg/kg).

Soil samples collected from borings CHI-2/87, CHI-6/87 and CHI-8/87 are considered to have moderately elevated levels of the parameters tested. Petroleum hydrocarbon oil and grease concentrations in these soil samples ranged from 1,100 mg/kg to 1,600 mg/kg. Because the soil from these borings demonstrated lower concentrations of contaminants than the samples from the western portion of this area of the site, these test borings are considered to loosely define the eastern edge of an area of contaminated soils.

The contaminant levels present in the soil samples collected from the remaining eight borings (CHI-1/87, CHI-3/87, CHI-7/87, CHI-9/87, CHI-1/88, CHI-5/88, CHI-7/88 and CHI-8/88) are considered to be low. Low concentrations of 0.11 mg/kg and 0.6 mg/kg PCBs were present in the soil samples from borings CHI-7/87 and CHI-1/88, respectively. Low concentrations of

chlorinated VOCs were present in the soil samples collected from borings CHI-9/87, CHI-1/88, CHI-5/88 and CHI-8/88. These chlorinated compounds included 12 ug/kg to 30 ug/kg 1,1,1-trichloroethane and 13 ug/kg to 14 ug/kg of trichloroethene. Petroleum hydrocarbon oil and grease was detected in seven of these borings and ranged from 120 mg/kg to 930 mg/kg. The data collected from these soil borings supports the indications that an area of oil-contaminated soils exists west of the dike area in the Northern Section of the site. It is anticipated that this area was heavily used during loading and off-loading of trucks.

Groundwater Monitoring Well Installation and Sampling. A groundwater monitoring well was installed in the boring identified as CHI-6/88 on February 17, 1988. The purpose of installing this well was to assess any impact to the groundwater from the oil contamination observed in the soils. Petroleum product was observed on the split spoon sampler at a depth of 2 and 8 feet in this boring, which was located next to and topographically downgradient from 13 former aboveground waste oil storage tanks.

The monitoring well was constructed of two-inch diameter polyvinyl chloride (PVC) pipe and was completed to a depth of 13 feet below the ground surface. The lower 10 feet were constructed of slotted PVC pipe (well screen) and the annular space between the screen and the bore hole was packed with Ottawa sand. Approximately one foot of bentonite clay was placed above the sand. The remaining annular space between the riser and the walls of the bore hole was backfilled with clean fill material. The Well Completion Report is included in Appendix D.

On February 18, 1988, a groundwater sample was collected from monitoring well CHI-6/88. At the time of sampling, the groundwater level was determined to be eight feet below the ground surface. The groundwater sample was collected using a pre-cleaned bailer after three volumes of water were bailed from the well. A petroleum odor was noted and a slight sheen was observed on the surface of the groundwater bailed from this well. The sample was chilled and delivered on the same day to Clean Harbors Analytical Services, Inc. for laboratory analysis.

The groundwater sample was analyzed for pH, PCBs, VOCs (by EPA Method 624), petroleum hydrocarbon oil and grease, 13 priority pollutant dissolved metals (plus barium), hexavalent chromium, sulfide and total cyanide. No PCBs or cyanide were detected in the groundwater

sample. A low sulfide concentration of 0.79 milligrams per liter (mg/l) was detected, and the pH was within normal levels at 6.2. The laboratory reports of analysis are included in Appendix E.

Petroleum hydrocarbon compounds were detected in the groundwater sample at a concentration of 82 mg/l. This petroleum hydrocarbon level was considered high and indicates an impact to the groundwater from the high petroleum hydrocarbons detected in the respective soil samples collected from this boring (16,000 mg/kg).

The VOCs detected in the groundwater sample included 1,1,1-trichloroethane (1,300 ug/l), 1,1-dichloroethane (2,200 ug/l) and trace levels of chloroethane. These compounds and relative proportions detected indicate possible degradation of 1,1,1-trichloroethane to 1,1-dichloroethane and, ultimately, to chloroethane.

The dissolved metals analytical results did not identify any metals present above the drinking water standards available in 1988. Hexavalent chromium was not detected in this groundwater sample.

Evaluation of Findings. A total of 17 borings were performed on the Northern Section of the site; nine borings were performed within the concrete dike and eight borings were performed west of the diked area. One monitoring well was installed in a boring west of the diked area where soils exhibited the most significant signs of contamination.

These borings were performed to assess the subsurface soil conditions on the Northern Section of the site for potential development purposes. The borings performed have been identified as structural borings. Since contamination was encountered, soil samples were collected for laboratory analysis to characterize the contamination.

Based on the laboratory analytical results, the most significantly contaminated areas appeared to be located west of diked area near the aboveground storage tanks which were removed from the site in April, 1988. The contamination appeared to be the result of residual oil releases associated with the former storage tanks in this area. Both the groundwater and soil samples collected from location CHI-6/88 indicated the presence of high levels of petroleum hydrocarbon oil and grease. Although a petroleum constituent (xylene) was detected in a soil sample collected

from CHI-6/88 but no chlorinated solvents, high levels of chlorinated solvents were detected in the groundwater sample from the same location. The existence of elevated levels of chlorinated solvents in the groundwater but not in surficial soil samples suggests that chlorinated solvents may have been migrating in the groundwater.

Structural Boring Program - Central Section

Sixteen structural soil borings were completed on the Central Section of the site in July 1988. These borings were performed in the new area of the proposed facility footprint in order to assess the subsurface conditions for geotechnical purposes. The borings were designated as B-1 through B-12 and their locations are shown on Figure 6.

General Subsurface Conditions. The general subsurface conditions that were observed in the Central Section of the site in the area of the facility are stated here based on the test boring data collected in the second structural boring program. The soils encountered in the Central Section of the site generally consisted of six feet to eight feet of variable density (very loose to very dense) fill material which overlies a medium-dense to dense sand or sand and gravel layer to the maximum boring depths of 15 to 20 feet. The fill material consisted of a matrix of sand, gravel and cobbles containing pockets of clayey silt, brick, concrete, asphalt, wood and cinders. Groundwater was encountered at a depth of approximately eight feet below the ground surface.

Six to 8 inches of petroleum-contaminated soil were encountered over the majority of proposed building footprint, during these structural borings. This contamination generally occurred approximately eight feet below the ground surface, near the groundwater table.

Structural Soil Borings - Drilling Activities. The soil borings were advanced using hollow-stem augers driven by a truck-mounted rotary drill rig to an average depth of 15 to 20 feet below the ground surface. Soil samples were collected using a split-spoon sampler which was driven into undisturbed soil. Soil samples were collected continuously from the ground surface to generally 12 feet below the ground surface. Usually, one or two additional split-spoon samples were collected directly above the termination depth of the bore hole. All soil samples were

delivered to Clean Harbors Analytical Services, Inc. the same day they were collected. No field screening for VOCs was performed during the second structural boring program. The Boring Logs are included in Appendix B.

Laboratory Results - Central Section. The soil samples collected for the structural borings in the Central Section of the site were composited in the laboratory for each boring based on visual identification of petroleum product and/or petroleum odor. The various composite samples were analyzed for VOCs (by EPA Method 8240), total and petroleum hydrocarbon oil and grease, PCBs, sulfides, organochlorine pesticides, 13 priority pollutant metals, E.P. Toxicity and BNAs.

This testing program was similar to the program performed for the Northern Section, however, it was modified to include pesticides due to the proximity of the Boston and Maine Railroad tracks to the site. In addition, no testing was performed for cyanide or pH based on the results of these parameters on the soils collected in the Northern Section. The analytical results are summarized in Tables 5 through 7 and are discussed below. The Laboratory Reports of Analysis are included in Appendix F.

Volatile organic compounds were detected in samples collected in nine of the 16 structural borings. The results are summarized in Table 5. The highest VOC concentrations observed were generally detected in composite samples of soils collected from approximately 7 to 12 feet below the ground surface; the depth where petroleum contamination was encountered. Petroleum constituents detected in these samples included benzene, toluene, ethylbenzene and xylenes (BTEX compounds). In every case, xylenes were present in the highest concentration relative to the petroleum-based compounds.

The highest BTEX concentration levels were observed in soil boring B-8 (8 to 12 feet). The sample analyzed from this interval indicated an elevated total BTEX measurement of 1,150 ug/kg; 790 ug/kg of this concentration was xylene. Elevated petroleum constituents were also detected in borings B-1 (0 to 4 feet and 14 - 16 feet), B-6 (7 to 11 feet) and B-11 (6 to 14 feet) with total BTEX concentrations ranging from 279 ug/kg to 369 ug/kg. The other soil boring samples with elevated BTEX levels had concentrations equal to or less than 90 ug/kg.

Additional hydrocarbon and chlorinated solvent compounds were detected in samples collected from nine of the 16 soil borings. These compounds included trichloroethene, trans-1,2-dichloroethane, methyl-t-butylether (MTBE) and acetone. The highest chlorinated compound concentrations occurred in boring B-6 (7 to 11 feet) and B-8 (7 to 8 feet), with concentrations of trans-1,2-dichloroethene of 290 ug/kg and 210 ug/kg, respectively. Acetone concentrations of 93 ug/kg and 160 ug/kg were also detected in B-6 and B-8, respectively. MTBE was only detected in the composite soil samples collected from boring B-1 (0 to 4 feet and 14 to 16 feet) at a concentration of 24 ug/kg. MTBE is an octane enhancer which typically is added to gasoline.

The laboratory results for total and petroleum hydrocarbon oil and grease are presented in Table 5. The highest concentration of petroleum hydrocarbons was found in samples collected from borings B-6 (in the composite samples from 7 to 11 feet) at 72,000 mg/kg, B-8 (7 to 8 feet) at 21,000 mg/kg, and B-11 (6 to 14 feet) at 10,000 mg/kg. Elevated levels of petroleum hydrocarbon oil and grease ranging from 1,600 mg/kg to 6,100 mg/kg were observed in borings B-1, B-3, B-7, B-9 and B-10. The petroleum hydrocarbon concentrations detected in the remaining four borings were below 870 mg/kg. Composite samples from borings B-6 (14 to 20 feet), B-9 (10 to 16 feet) and B-12 (8 to 12 feet and 18 to 20 feet) indicated petroleum hydrocarbons ranging from 17 mg/kg to 56 mg/kg. The highest petroleum hydrocarbon concentrations were detected in composite soil samples collected from a depth of approximately seven to 12 feet below the ground surface (consistent with the petroleum hydrocarbon VOC laboratory results).

BNA analyses were performed on some of the composite soil samples collected from each of the borings. The results are summarized in Table 6. As many as 19 different BNA compounds were detected in 20 of the 26 composite samples tested. The sample with the highest BNA concentration was collected from test boring B-7, composited from 4 to 10 feet. The total BNA concentration in this sample was 383,700 ug/kg, with pyrene being the compound with the single highest concentration of 87,000 ug/kg. The overall compounds detected were indicative of a waste oil, and the highest levels of contamination in each boring seemed to occur at the depth where heavy petroleum contamination was encountered during drilling (5 to 12 feet).

The 13 priority pollutant total metals (plus barium) analyses were performed on some composite soil samples collected from each boring. The laboratory results for these analyses are presented in Table 7. Similar to the Northern Section, soil analyses of samples from structural borings in

the Central Section detected some metals (cadmium, lead, and mercury) at concentrations which are considered to be elevated compared to published values for natural soils. Cadmium was detected at a maximum concentration of 4.8 mg/kg (boring B-6 at 7-11 feet), which significantly exceeds the published average value of 0.06 mg/kg. Lead (maximum of 6,500 mg/kg in boring B-6 at 7-11 feet) and mercury (0.44 mg/kg) were also considered to be elevated compared to the published average values for natural soils (10 mg/kg and 0.03 mg/kg, respectively). Antimony (maximum of 190 mg/kg) and thallium (maximum of 30 mg/kg) were also detected at levels which are considered high, however no published values for natural soils are available. Hexavalent chromium was not analyzed in the Central Section structural boring program.

In addition, 26 composite samples were also analyzed for E.P. Toxicity priority pollutant 8 metals. Only five of the eight metals evaluated were detected by the analysis. The metals which were observed only at low concentrations included cadmium, chromium, barium, mercury and lead. Lead was detected during the total metals analysis and also as a leachable metal.

No PCB compounds or pesticides were detected in any of the soil boring samples. The concentrations of sulfide in the soil tested were relatively low and ranged between 2.0 mg/kg and 49 mg/kg.

Evaluation of Findings. Sixteen structural borings were performed on the Central Section of the site in the area of the facility building to assess the subsurface soil conditions. Historically, this portion of the site was used as an "oil pit" during the 1950s. Based on the laboratory analytical results, the soils heavily contaminated with petroleum existed across the northeastern half of the facility footprint (in the vicinity of borings B-6, B-7, B-8 and B-11), at a depth generally between 5 and 12 feet. The degree of soil contamination appeared to decrease radially away from this area. Some of these contaminated soils were subsequently removed during construction of the new facility, as will be discussed later.

Chlorinated VOCs were detected in soil borings B-1, B-3, B-5, B-6, B-7, B-8, B-10 and B-11, generally in the composite soil samples collected within the upper 12 feet. The source of the chlorinated VOCs detected on the Central Section of the site is unknown. A possible source of these compounds may have been the groundwater, since the soil samples were collected in part below the water table.

The analytical results, which were based on soil data only, indicated that the contamination by oil residuals appeared to be primarily in the area of the proposed facility in the Central Section of the site (particularly including the area encompassed by borings B-6, B-7, B-8 and B-11). Based on the information collected during this and the first (northern) structural boring program, the heaviest soil contamination was observed within the Central Section of the site. Because the extent of petroleum contamination in the Central Section of the site was not be delineated by the structural boring program, a third program of environmental soil borings/groundwater monitoring wells was performed to assess the extent of contamination in the Central Section of the site. This investigation is discussed below.

Environmental Investigation - Central Section

Eight soil borings were performed on the Central Section of the site on January 30 and February 3, 1989. The borings for this phase of work were located around the proposed facility footprint to evaluate the extent of petroleum contamination in this portion of the site. The borings were identified as W-89-S1, W-89-S3, W-89-S4, and W-89-S14 through W-89-S18 and their locations are shown on Figure 6.

General Subsurface Conditions. The general subsurface soil conditions that were present across the Central Section of the site included a four- to twelve-foot thick layer of variable density granular fill above a relatively clean medium-dense to very-dense cobbley sand and gravel. The fill material ranged in density from very loose (four to six feet below grade in the southern portion of the proposed building footprint) to very dense, and consisted of a matrix of sand, gravel and cobbles containing pockets of clayey silt, wood, bricks, concrete, asphalt and cinders. The lower portion of this fill layer contained fibrous organic debris. The natural sand and gravel deposit which occurred four to 12 feet below the ground surface, extended to the maximum boring depth of 30 feet below grade. Groundwater was encountered at a depth of approximately eight feet below the ground surface.

Environmental Soil Borings - Drilling Activities. The soil borings were advanced using hollow-stem augers driven by a truck-mounted rotary drill rig from 10 to 12 feet below the ground surface (a minimum of 2 feet into the groundwater table). In two of the test borings, two additional samples were collected at 15 to 17 feet and 28 to 30 feet. Each soil sample was classified in the field and screened for headspace VOCs using an organic vapor analyzer (OVA) and headspace methodologies. The OVA meter was utilized during this exploration program because it is able to detect a greater variety of organic compounds than the HNU meter, including many of the chlorinated compounds detected previously at the site. Soil samples with elevated readings were submitted to Clean Harbors Analytical Services, Inc. for laboratory analysis. Some soil samples were submitted for analysis based solely on visual and olfactory observations made in the field.

Heavy petroleum contamination (12 to 18 inches of oil-saturated soil generally occurring eight feet below the ground surface) was encountered in the soil borings identified as W-89-S1 and W-89-S17. The headspace readings for the soils in these borings were the highest detected during this investigation and registered levels greater than 1,000 ppm. OVA readings between 10 ppm and 90 ppm were detected in all the remaining soil borings except for W-89-S15 and W-89-S16 where levels less than 10 ppm were recorded.

Laboratory Results of Soil Samples. All soil samples collected from the environmental borings in the Central Section of the site were chilled and submitted to Clean Harbors Analytical Services, Inc. the same day that they were collected. Soil samples were analyzed in the laboratory for VOCs (by EPA Method 8240) and total and petroleum hydrocarbon oil and grease. Selected samples were additionally analyzed for PCBs, sulfides, phenols and BNAs. The laboratory results from these tests are included in Appendix G and the results are summarized in Tables 8 and 9. This analytical program was changed from the previous analytical testing program to include phenol analysis based on the site proximity to the western abutting property, the John J. Riley Tannery. No analyses were run for pesticides, total cyanide or pH because the previous sample results were well within normal ranges.

The results from the samples tested for volatile organic compounds, PCBs, sulfides and phenols were generally very low concentrations or below laboratory method detection limits. The highest BTEX concentration was detected in the boring for W-89-S18 (six to eight feet) at 22 ug/kg.

Methylene chloride was the only chlorinated compound detected in soil samples from borings W-89-S3, W-89-S14, W-89-S16 and W-89-S17. This compound was detected in soil samples collected from the ground surface to a depth of two feet, with concentrations ranging from trace to 18 ug/kg, and may be indicative of a surficial release, possibly an oil which was spread as a dust control measure. A PCB compound (Aroclor 1254) was detected in only one soil sample (W-89-S4 at a depth of eight to ten feet below the ground surface) at a low concentration of 0.2 mg/kg.

BNA analyses were performed at various depths on three of eight soil borings completed in the environmental investigation. The three samples submitted for BNA analysis were selected based on the degree of visual petroleum contamination and elevated OVA readings. All but one of these tests indicated concentrations below the laboratory method detection limits. The BNA results for the soil sample collected at a depth of six to eight feet from W-89-S17 indicated a total BNA concentration of 3,470 ug/kg. The compounds detected are indicative of waste oils, and the analytical results are summarized in Table 9.

The levels of petroleum hydrocarbon oil and grease found in the soil samples analyzed were considered high. The highest concentration of petroleum contamination was detected in samples collected near the groundwater table. The highest concentrations of petroleum hydrocarbons were found in soil borings W-89-1 (8 to 10 feet), W-89-S17 (8 to 10 feet) and W-89-S18 (6 to 8 feet) with respective concentrations of 18,000 mg/kg, 14,000 mg/kg and 20,000 mg/kg. Lesser concentrations of petroleum hydrocarbons (from 280 mg/kg to 6,500 mg/kg) were encountered in borings W-89-S4 and W-89-S14. The least significant oil and grease contamination were observed in test borings W-89-S3, W-89-S15 and W-89-S16, where concentrations ranged from non detectable to 380 mg/kg.

Groundwater Monitoring Well Installation and Sampling. The eight borings performed on the Central Section of the site were completed as groundwater monitoring wells. The monitoring wells were constructed of two-inch diameter polyvinyl chloride (PVC) pipe. The monitoring wells were generally completed to an average depth of 20 feet below the ground surface, with screen lengths ranging from 10 to 25 feet. The wells were constructed as described above. Well Completion Reports are presented in Appendix D.

On February 3, 1989, groundwater samples were collected from all eight monitoring wells installed in the environmental investigation and well CHI-6/88 in the Northern Section. At least three volumes of groundwater were removed from each well prior to sampling. The groundwater samples were collected using precleaned Teflon bailers after recharge of the groundwater level in each monitoring well. All of the groundwater samples were chilled and delivered the same day to Clean Harbors Analytical Services, Inc. for laboratory analysis.

The groundwater samples were analyzed for VOCs (by EPA Method 624) and total and petroleum hydrocarbon oil and grease. The Laboratory Reports of Analyses are presented in Appendix E and the results are shown in Table 10.

The levels of petroleum hydrocarbon oil and grease found in these groundwater samples are considered moderate to high. The results for petroleum hydrocarbon oil and grease concentrations ranged from below laboratory method detection levels to 56 ppm. The highest concentration of oil and grease occurred in monitoring well W-89-S1, which is located northeast of the facility.

The results from the VOC analyses indicated generally low concentrations of BTEX compounds ranging from below laboratory method detection levels to 28 ug/l in W-89-17. Other VOCs detected in groundwater in the Central Section of the site included trans-1,2-dichloroethene, tetrachloroethene and acetone with respective maximum concentrations of 93 ug/l, 6 ug/l and 99 ug/l.

The highest concentration of chlorinated VOCs in groundwater were observed in well CHI-6/88, located in the Northern Section of the site. In that well, a total VOC concentration of 4,110 ug/l was detected, including the individual constituents of 1,1-dichloroethane (1,700 ug/l), 1,1,1-trichloroethane (1,400 ug/l), 2-butanone (850 ug/l), and chloroethane (160 ug/l). These results are consistent with those obtained during a previous sampling of well CHI-6/88 on February 18, 1988, when a total VOC concentration of 3,500 ug/l was detected, including the primary constituents of 1,1-dichloroethane and 1,1,1-trichloroethane. These data indicate that a persistent plume of chlorinated VOCs in groundwater existed in the Northern Section of the site, which was not evident in the Central Section.

All of the groundwater monitoring wells installed on the site were subsequently lost during the construction of the facility in 1989 and 1990.

Evaluation of Findings. Based on the laboratory analytical results, the highest petroleum concentrations were observed across the northeastern half of the proposed facility footprint at a depth generally between 5 and 12 feet. This information is consistent with the findings from the structural boring program conducted previously. The highest contamination was detected in samples from borings W-89-S1 and W-89-S17. The degree of soil contamination appeared to decrease radially away from these boring locations. The contamination appeared to consist primarily of oil residuals from waste oil, with elevated levels of petroleum hydrocarbon oil and grease and BNAs.

Chlorinated compounds were detected in soil borings W-89-S3, W-89-S14, W-89-S16, W-89-S17 and W-89-S18. Methylene chloride was the only chlorinated compound detected in soil borings W-89-S3, W-89-S14, W-89-S16 and W-89-S17. This compound was detected in soil samples collected at depths up to two feet below grade with concentrations ranging from trace to 18 ug/kg. Trace concentrations of tetrachloroethene and 2-butanone were detected in soil samples collected from boring W-89-S18 (6 to 10 feet), and concentrations of 71 ug/kg and 27 ug/kg of trichloroethene and trans-1,2-dichloroethene, respectively, were detected in the soil sample collected 8 to 10 feet below the ground surface.

Groundwater analyses of samples obtained from well CHI-6/88 in the Northern Section of the site detected elevated levels of chlorinated VOCs (specifically 1,1-dichloroethane and 1,1,1-trichloroethane) at a total concentration of 4,110 ug/l, which is consistent with the results of an earlier analysis. The groundwater analyses indicated relatively low levels of chlorinated compounds in groundwater in the Central Section of the site, including trans-1,2-dichloroethene, tetrachloroethene and trichloroethene. The source of the chlorinated VOCs in groundwater on the site is not known.

The soil analytical results indicated that contamination by oil residuals appeared to be located primarily in the area of the proposed facility building in the Central Section of the site (particularly including the area encompassed by W-89-S1 and W-89-S17). This information may

be indicative of the reported historical use of this portion of the site in the 1950s as an oil pit for disposal of waste oils.

SHORT TERM MEASURE

Based on the results of the two structural boring programs and environmental investigation discussed above, petroleum-contaminated soils were detected in the Central Section of the site, in the general area of the proposed building footprint. In order to proceed with the construction of the facility, Murphy's applied for a Short-Term Remedial Measure (STM) in February of 1989. The STM involved the removal of contaminated soil as excavation for construction of the facility proceeded. The STM was approved by the DEP on March 16, 1989, and site activities began on March 20, 1989.

Between March 20 and April 14, 1989, approximately 1,100 cubic yards of oil-contaminated soils were excavated from the footprint area of the proposed facility. The soils were temporarily stockpiled west of the former tank farm in the Northern Section of the site, and were placed on and covered with polyethylene sheeting during their residence time at the site. Eighteen soil samples were collected from the stockpiled soil and laboratory analyzed for disposal parameters. From June 19 to 26, 1989, the soils were transported to the CWS landfill in Norridgewock, Maine. Documentation concerning these events, including Uniform Hazardous Waste Manifests, were submitted to the DEP in February, 1990.

CONCLUSIONS

Based upon the data collected during the two structural boring programs and environmental investigation completed on the site between December 1987 and February 1989, the following conclusions can be made:

- Groundwater data collected on the site in 1988 - 1989 indicates that a persistent plume of chlorinated VOCs existed in groundwater in the Northern Section of the site. The presence of this plume was not evident in the Central Section. The source of the

chlorinated VOCs in groundwater on the site is not known, however, the plume could have originated from an upgradient off-site location.

- Chlorinated VOCs were also detected in some soil samples analyzed during the structural boring programs and environmental investigation. Since elevated levels of chlorinated VOC contamination were more evident in soil at greater depths, the soil contamination may have resulted from contaminated groundwater migrating onto the site.

- The most significant petroleum contamination on the site was identified within the Central Section of the site in the area of the new facility.

- A less significant level of petroleum contamination was detected in the Northern Section of the site, west of the diked area.

- The petroleum contamination identified in the site soils appears to be residual waste oil contamination associated with previous site activities. These activities included incidental releases and more importantly, historical use of petroleum as dust control and historical dumping of petroleum in a waste pit.

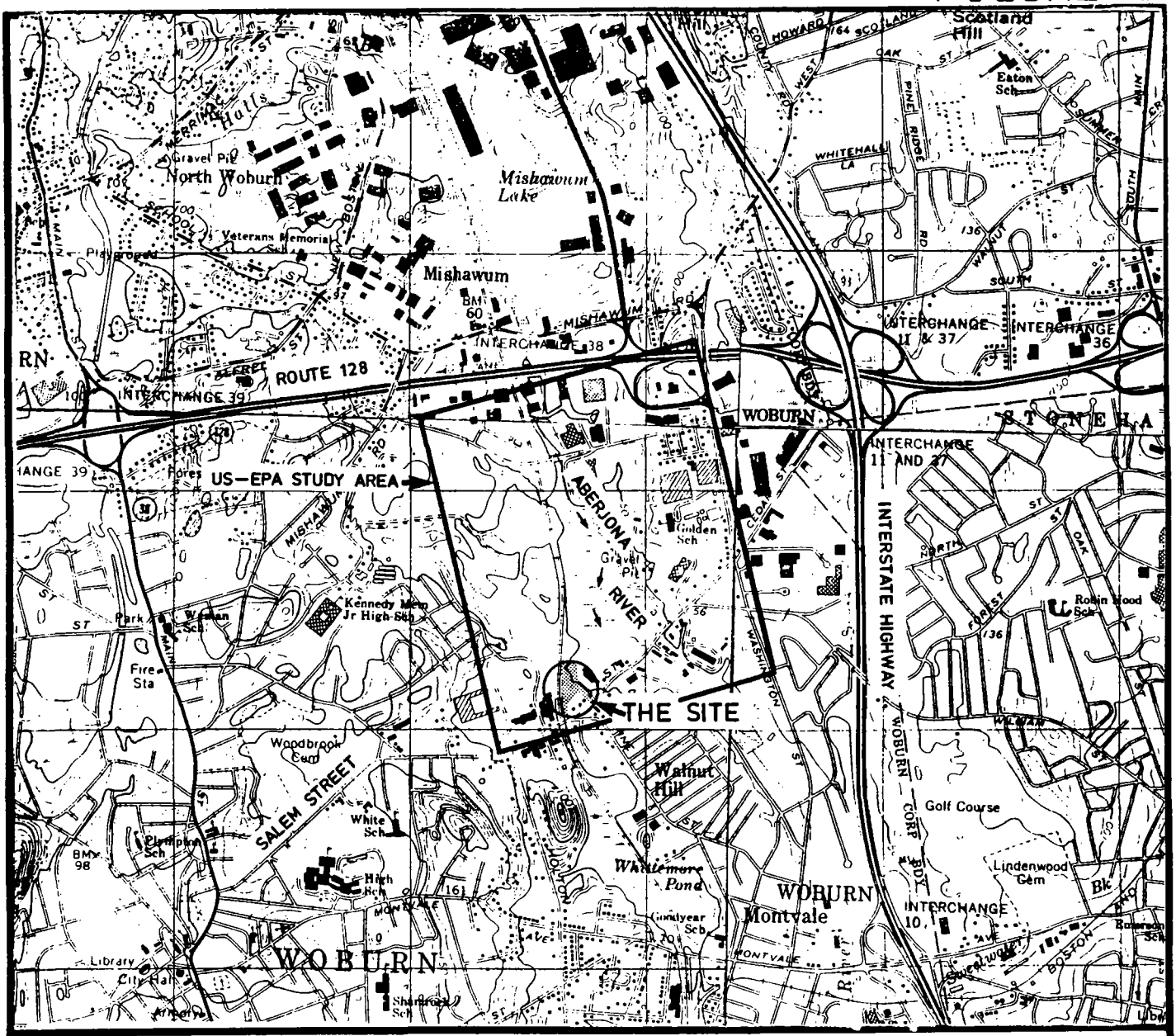
RECOMMENDATIONS

Based on the previous investigations performed at the site, petroleum and chlorinated organic contamination has been detected in the site soils and groundwater. The previous site work did not determine the extent or the source(s) of this contamination. Further, additional site-specific information regarding site geology and hydrogeology needs to be gathered in order to satisfy the requirements of the Part B Permit. These data gaps include, but are not limited to, soil types and depths, depth to bedrock, site-specific and regional geologic cross-sections, and current soil and groundwater quality at the site. A detailed re-evaluation of the Wells G&H study area, inclusive of recent on-site data, is currently being completed by Remediation Technologies Inc (Retec), and will be summarized in a report that is currently scheduled to be available in the Spring of 1994. The Retec report will update, and perhaps significantly revise, information presented in this Report. In addition, it may also include information required to complete portions of the Part B Permit requirements referenced above.

CHES recommends that, following receipt and review of the Retec report, a Scope of Work be prepared to complete the hydrogeologic characterization of the Murphy's site. The Scope of Work will detail the placement and installation of new soil borings/groundwater monitoring wells, soil and groundwater sampling parameters and additional file review and research necessary to satisfy the requirements stipulated in Paragraphs 10(b) and (c) of the Part B Permit. Based on the currently scheduled Spring 1994 availability of the Retec report, the Scope of Work will be submitted to the DEP by June 30, 1994. Should any delays in the issuance of the Retec report result in a delay in the submittal of the Scope of Work, the DEP will be contacted regarding an extension of this submittal date.

FIGURES

FIGURE 1



SCALE 1:25 000

1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 5 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

QUADRANGLE LOCATION

N

COORDINATES
UTM: 324682mE 4706254mN
LONGITUDE: [redacted]
LATITUDE: [redacted]

ISSUE	DESCRIPTION	DRWN.	CHKD.	APPR.	DATE
		KMG			1/31/94

Clean Harbors
ENVIRONMENTAL ENGINEERING CORPORATION

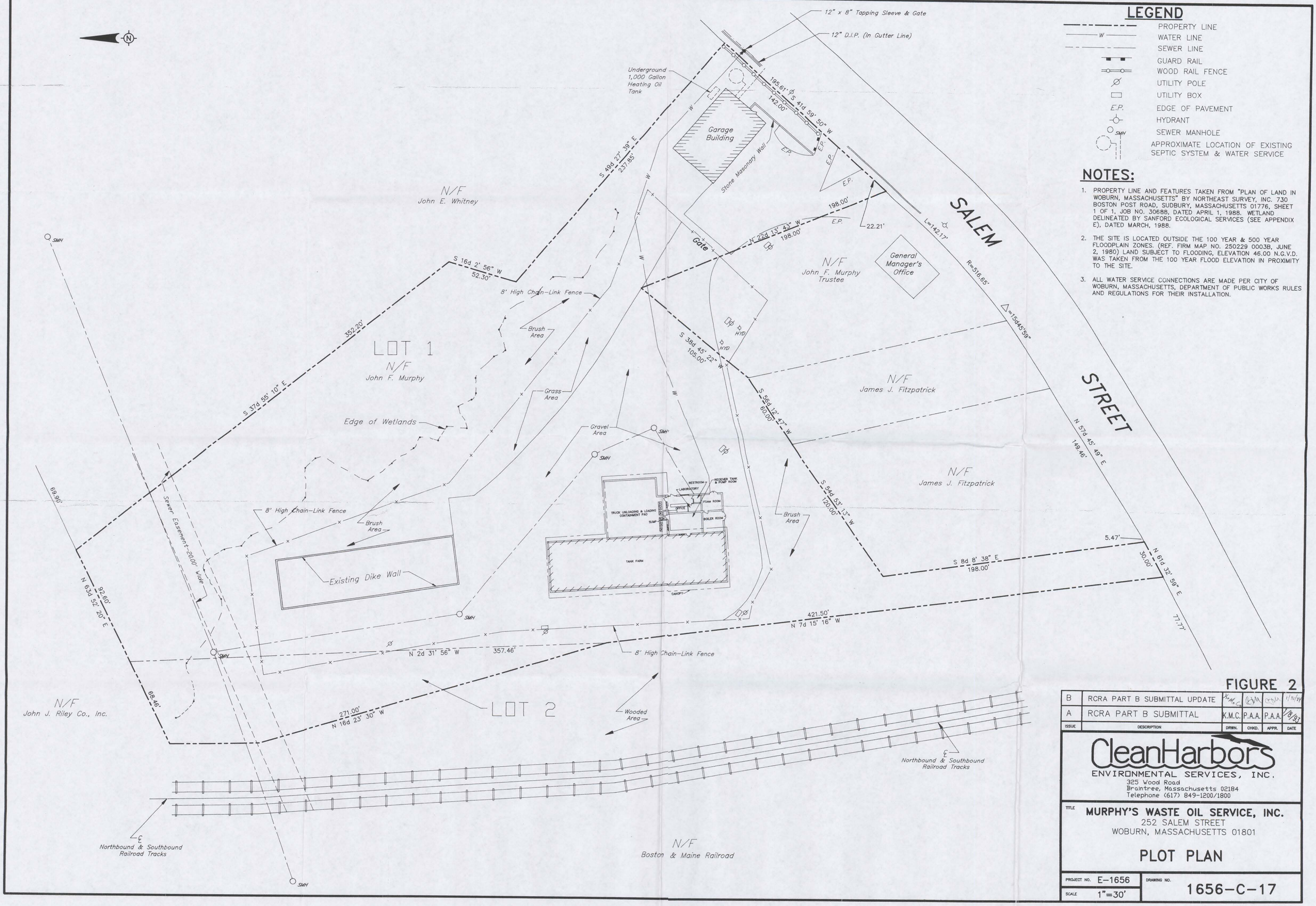
325 Wood Road
Braintree, Massachusetts 02184
Telephone (617) 849-1200

MURPHY'S WASTE OIL SERVICE, INC.
252 AND 252 REAR SALEM STREET
WOBURN, MASSACHUSETTS

LOCUS MAP

PROJECT NO. E-1656	DWG. NO. 1656-L-001
SCALE AS NOTED	

BASE MAP: UNITED STATES GEOLOGICAL SURVEY (USGS) LEXINGTON, MASSACHUSETTS QUADRANGLE



LEGEND

- PROPERTY LINE
- W — WATER LINE
- SEWER LINE
- GUARD RAIL
- WOOD RAIL FENCE
- UTILITY POLE
- UTILITY BOX
- E.P. — EDGE OF PAVEMENT
- HYDRANT
- SMH — SEWER MANHOLE
- APPROXIMATE LOCATION OF EXISTING SEPTIC SYSTEM & WATER SERVICE

NOTES:

1. PROPERTY LINE AND FEATURES TAKEN FROM "PLAN OF LAND IN WOBURN, MASSACHUSETTS" BY NORTHEAST SURVEY, INC. 730 BOSTON POST ROAD, SUDBURY, MASSACHUSETTS 01776, SHEET 1 OF 1, JOB NO. 30688, DATED APRIL 1, 1988. WETLAND DELINEATED BY SANFORD ECOLOGICAL SERVICES (SEE APPENDIX E), DATED MARCH, 1988.
2. THE SITE IS LOCATED OUTSIDE THE 100 YEAR & 500 YEAR FLOODPLAIN ZONES. (REF. FIRM MAP NO. 250229 0003B, JUNE 2, 1980) LAND SUBJECT TO FLOODING, ELEVATION 46.00 N.G.V.D. WAS TAKEN FROM THE 100 YEAR FLOOD ELEVATION IN PROXIMITY TO THE SITE.
3. ALL WATER SERVICE CONNECTIONS ARE MADE PER CITY OF WOBURN, MASSACHUSETTS, DEPARTMENT OF PUBLIC WORKS RULES AND REGULATIONS FOR THEIR INSTALLATION.

FIGURE 2

ISSUE	DESCRIPTION	DRWN.	CHKD.	APPR.	DATE
B	RCRA PART B SUBMITTAL UPDATE	K.M.C.	P.A.A.	P.A.A.	1/31/94
A	RCRA PART B SUBMITTAL	K.M.C.	P.A.A.	P.A.A.	1/8/93

CleanHarbors
ENVIRONMENTAL SERVICES, INC.
325 Wood Road
Braintree, Massachusetts 02184
Telephone (617) 849-1200/1800

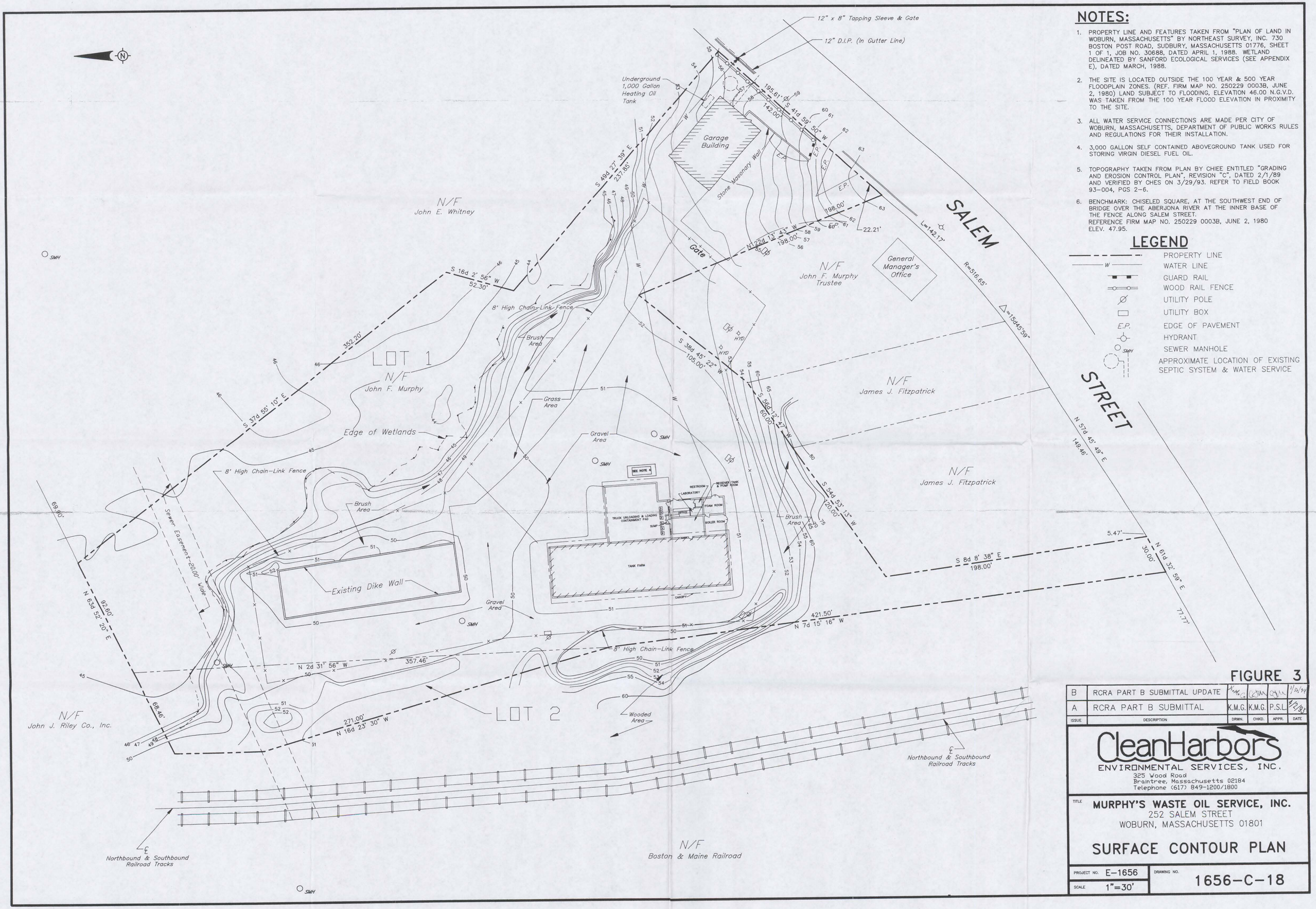
TITLE

MURPHY'S WASTE OIL SERVICE, INC.

252 SALEM STREET
WOBURN, MASSACHUSETTS 01801

PLOT PLAN

PROJECT NO.	DRAWING NO.
E-1656	1656-C-17
SCALE 1"=30'	



NOTES:

1. PROPERTY LINE AND FEATURES TAKEN FROM "PLAN OF LAND IN WOBURN, MASSACHUSETTS" BY NORTHEAST SURVEY, INC. 730 BOSTON POST ROAD, SUDBURY, MASSACHUSETTS 01776, SHEET 1 OF 1, JOB NO. 30688, DATED APRIL 1, 1988. WETLAND DELINEATED BY SANFORD ECOLOGICAL SERVICES (SEE APPENDIX E), DATED MARCH, 1988.
2. THE SITE IS LOCATED OUTSIDE THE 100 YEAR & 500 YEAR FLOODPLAIN ZONES. (REF. FIRM MAP NO. 250229 0003B, JUNE 2, 1980) LAND SUBJECT TO FLOODING, ELEVATION 46.00 N.G.V.D. WAS TAKEN FROM THE 100 YEAR FLOOD ELEVATION IN PROXIMITY TO THE SITE.
3. ALL WATER SERVICE CONNECTIONS ARE MADE PER CITY OF WOBURN, MASSACHUSETTS, DEPARTMENT OF PUBLIC WORKS RULES AND REGULATIONS FOR THEIR INSTALLATION.
4. 3,000 GALLON SELF CONTAINED ABOVEGROUND TANK USED FOR STORING VIRGIN DIESEL FUEL OIL.
5. TOPOGRAPHY TAKEN FROM PLAN BY CHIEE ENTITLED "GRADING AND EROSION CONTROL PLAN", REVISION "C", DATED 2/1/89 AND VERIFIED BY CHES ON 3/29/93. REFER TO FIELD BOOK 93-004, PGS 2-6.
6. BENCHMARK: CHISELED SQUARE, AT THE SOUTHWEST END OF BRIDGE OVER THE ABERJONA RIVER AT THE INNER BASE OF THE FENCE ALONG SALEM STREET.
   REFERENCE FIRM MAP NO. 250229 0003B, JUNE 2, 1980
   ELEV. 47.95.

LEGEND

- PROPERTY LINE
- W — WATER LINE
- GUARD RAIL
- WOOD RAIL FENCE
- UTILITY POLE
- UTILITY BOX
- E.P. — EDGE OF PAVEMENT
- HYDRANT
- SMH — SEWER MANHOLE
- APPROXIMATE LOCATION OF EXISTING SEPTIC SYSTEM & WATER SERVICE

FIGURE 3

ISSUE	DESCRIPTION	DRWN.	CHKD.	APPR.	DATE
B	RCRA PART B SUBMITTAL UPDATE	K.M.G.	K.M.C.	P.S.L.	11/21/94
A	RCRA PART B SUBMITTAL	K.M.G.	K.M.C.	P.S.L.	8/12/93

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TITLE
MURPHY'S WASTE OIL SERVICE, INC.
252 SALEM STREET
WOBURN, MASSACHUSETTS 01801

SURFACE CONTOUR PLAN

PROJECT NO.	DRAWING NO.
E-1656	1656-C-18
SCALE 1"=30'	

LEGEND

- PROPERTY LINE
- W — WATER LINE
- GUARD RAIL
- WOOD RAIL FENCE
- UTILITY POLE
- UTILITY BOX
- E.P. — EDGE OF PAVEMENT
- HYDRANT
- SMH — SEWER MANHOLE
- FORMER TANK
- APPROXIMATE LOCATION OF EXISTING SEPTIC SYSTEM & WATER SERVICE

NOTES:

1. PROPERTY LINE AND FEATURES TAKEN FROM "PLAN OF LAND IN WOBURN, MASSACHUSETTS" BY NORTHEAST SURVEY, INC. 730 BOSTON POST ROAD, SUDBURY, MASSACHUSETTS 01776, SHEET 1 OF 1, JOB NO. 30688, DATED APRIL 1, 1988. WETLAND DELINEATED BY SANFORD ECOLOGICAL SERVICES (SEE APPENDIX E), DATED MARCH, 1988.
2. THE SITE IS LOCATED OUTSIDE THE 100 YEAR & 500 YEAR FLOODPLAIN ZONES. (REF. FIRM MAP NO. 250229 0003B, JUNE 2, 1980) LAND SUBJECT TO FLOODING, ELEVATION 46.00 N.G.V.D. WAS TAKEN FROM THE 100 YEAR FLOOD ELEVATION IN PROXIMITY TO THE SITE.
3. ALL WATER SERVICE CONNECTIONS ARE MADE PER CITY OF WOBURN, MASSACHUSETTS, DEPARTMENT OF PUBLIC WORKS RULES AND REGULATIONS FOR THEIR INSTALLATION.
4. 3,000 GALLON SELF CONTAINED ABOVEGROUND TANK USED FOR STORING VIRGIN DIESEL FUEL OIL.

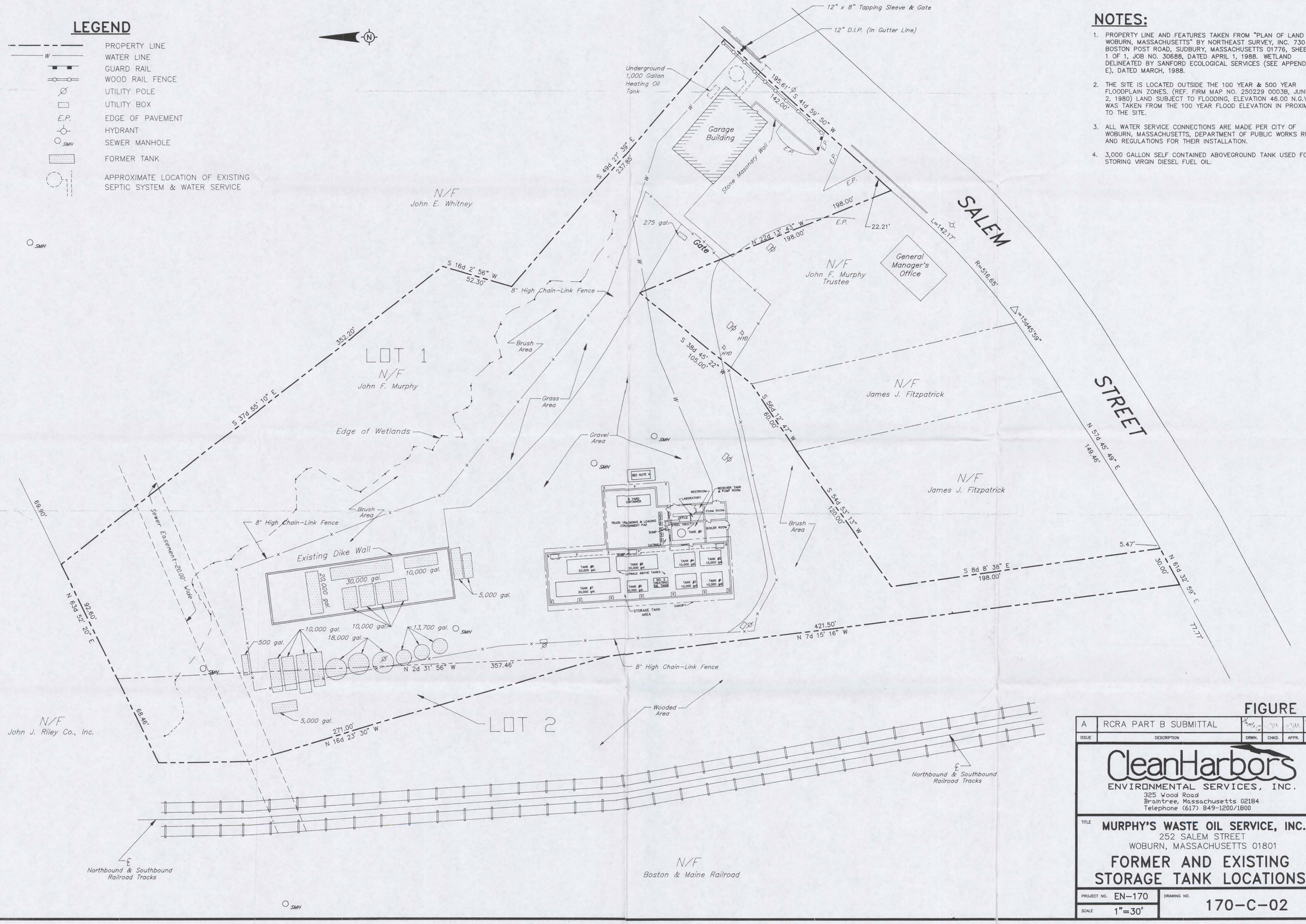


FIGURE 4

ISSUE	DESCRIPTION	DRWN.	CHKD.	APPR.	DATE
A	RCRA PART B SUBMITTAL	[illegible]	[illegible]	[illegible]	1/31/94

CleanHarbors
ENVIRONMENTAL SERVICES, INC.
325 Wood Road
Braintree, Massachusetts 02184
Telephone (617) 849-1200/1800

TITLE

MURPHY'S WASTE OIL SERVICE, INC.
252 SALEM STREET
WOBURN, MASSACHUSETTS 01801

FORMER AND EXISTING STORAGE TANK LOCATIONS

PROJECT NO.	DRAWING NO.
EN-170	170-C-02
SCALE 1"=30'	

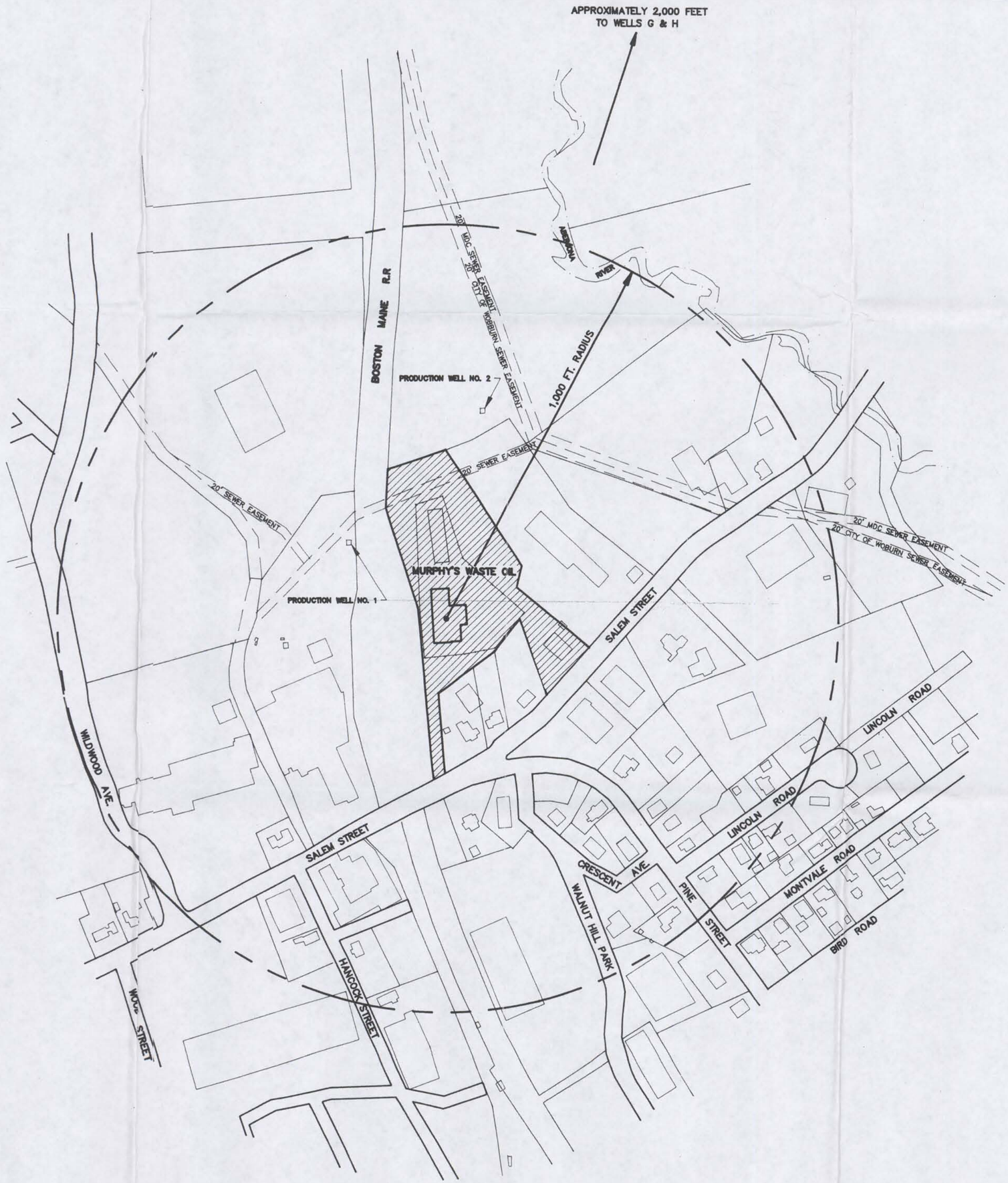


FIGURE 5

ISSUE	DESCRIPTION	DRWN.	CHKD.	APPR.	DATE
B	RCRA PART B SUBMITTAL UPDATE	K.M.C.			1/31/94
A	RCRA PART B SUBMITTAL	K.M.C.	P.A.A.	P.A.A.	1/8/93

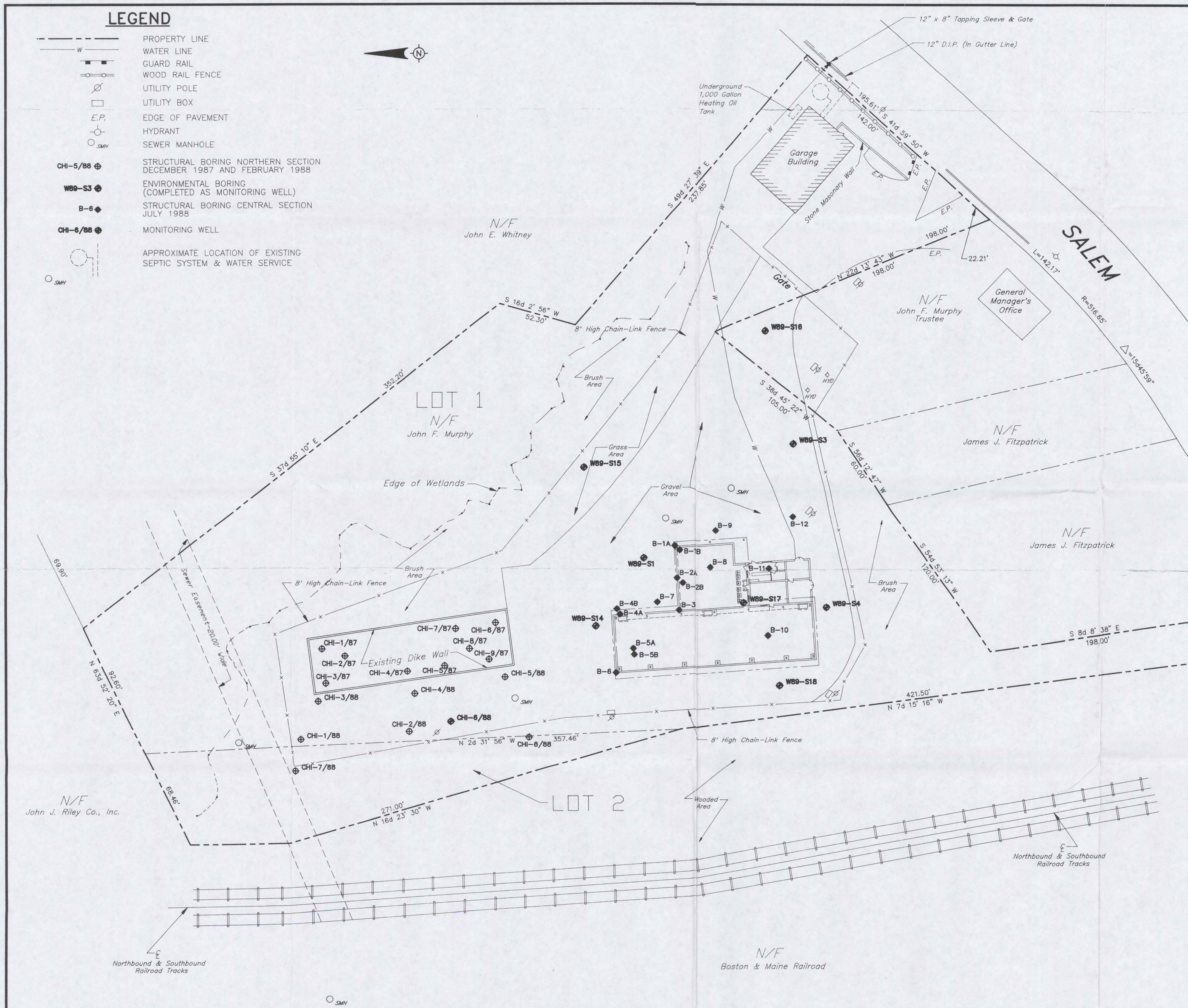
CleanHarbors
ENVIRONMENTAL SERVICES, INC.
325 Wood Road
Braintree, Massachusetts 02184
Telephone (617) 849-1200/1800

TITLE

MURPHY'S WASTE OIL SERVICE, INC.
252 SALEM STREET
WOBURN, MASSACHUSETTS 01801

SURROUNDING AREA MAP

PROJECT NO.	DRAWING NO.
E-1656	1656-C-15
SCALE 1"=200'	


LEGEND
PROPERTY LINE
WATER LINE
GUARD RAIL
WOOD RAIL FENCE
UTILITY POLE
UTILITY BOX
EDGE OF PAVEMENT
HYDRANT
SEWER MANHOLE
CHI-5/88 STRUCTURAL BORING NORTHERN SECTION DECEMBER 1987 AND FEBRUARY 1988
W89-S3 ENVIRONMENTAL BORING (COMPLETED AS MONITORING WELL)
B-6 STRUCTURAL BORING CENTRAL SECTION JULY 1988
CHI-6/88 MONITORING WELL
APPROXIMATE LOCATION OF EXISTING SEPTIC SYSTEM & WATER SERVICE
12" x 8" Tapping Sleeve & Gate
12" D.I.P. (In Gutter Line)
Underground 1,000 Gallon Heating Oil Tank
Garage Building
Stone Masonary Wall
SALEM
STREET
N/F John E. Whitney
N/F John F. Murphy Trustee
General Manager's Office
LOT 1
N/F John F. Murphy
N/F James J. Fitzpatrick
N/F James J. Fitzpatrick
8' High Chain-Link Fence
Brush Area
Grass Area
Gravel Area
Edge of Wetlands
Existing Dike Wall
Sewer Easement 20.00' Wide
LOT 2
Wooded Area
N/F John J. Riley Co., Inc.
N/F Boston & Maine Railroad
Northbound & Southbound Railroad Tracks
Northbound & Southbound Railroad Tracks

NOTES:

1. PROPERTY LINE AND FEATURES TAKEN FROM "PLAN OF LAND IN WOBURN, MASSACHUSETTS" BY NORTHEAST SURVEY, INC. 730 BOSTON POST ROAD, SUDBURY, MASSACHUSETTS 01776, SHEET 1 OF 1, JOB NO. 30688, DATED APRIL 1, 1988. WETLAND DELINEATED BY SANFORD ECOLOGICAL SERVICES (SEE APPENDIX E), DATED MARCH, 1988.
2. THE SITE IS LOCATED OUTSIDE THE 100 YEAR & 500 YEAR FLOODPLAIN ZONES. (REF. FIRM MAP NO. 250229 0003B, JUNE 2, 1980) LAND SUBJECT TO FLOODING, ELEVATION 46.00 N.G.V.D. WAS TAKEN FROM THE 100 YEAR FLOOD ELEVATION IN PROXIMITY TO THE SITE.
3. ALL WATER SERVICE CONNECTIONS ARE MADE PER CITY OF WOBURN, MASSACHUSETTS, DEPARTMENT OF PUBLIC WORKS RULES AND REGULATIONS FOR THEIR INSTALLATION.

FIGURE 6

ISSUE	DESCRIPTION	DRWN.	CHKD.	APPR.	DATE
A	RCRA PART B SUBMITTAL				1/31/94

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ENVIRONMENTAL SERVICES, INC.
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Telephone (617) 849-1200/1800

TITLE
MURPHY'S WASTE OIL SERVICE, INC.
252 SALEM STREET
WOBURN, MASSACHUSETTS 01801

FORMER MONITORING WELLS & BORINGS

PROJECT NO. EN-170
SCALE 1"=30'
DRAWING NO. 170-C-01

TABLES

Table 1
Soil Analytical Results - Organic Analyses
Northern Section (December 1987)

Sample ID	CHI-1/87	CHI-2/87	CHI-3/87	CHI-4/87	CHI-5/87	CHI-6/87	CHI-7/87	CHI-8/87	CHI-9/87
Sample Depth (ft)	0-8	0-10	0-10	0-10	0-8	0-10	0-8	0-8	0-8
VOCs, ug/kg									
Acetone	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
Benzene	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
Toluene	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
Ethylbenzene	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
Xylenes	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
1,1-Dichloroethane	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
Tetrachloroethene	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
1,1,1-Trichloroethane	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	12
Trichloroethene	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	13
BNAs, ug/kg	---	---	---	---	ND(330)	---	---	---	---
Petroleum Hydrocarbons, mg/kg	700	1,600	750	3,500	3,800	1,100	380	1,600	490
PCBs, mg/kg									
Aroclor 1260	ND(1.0)	ND(1.0)	ND(1.0)	ND(5.0)	ND(1.0)	0.21	0.11	ND (0.1)	ND(0.1)
Sulfides, mg/kg	2.9	7.2	6.1	3.6	6	19	9.4	4.6	17
pH	5.6	7.2	6.5	5.9	6.8	6.2	5.2	5.6	5.6

Notes:
VOCs = Volatile Organic Compounds
BNAs = Base/Neutral and Acid Extractible Semi-Volatile Organic Compounds
PCBs = Polychlorinated biphenyl compounds
ug/kg = Micrograms per kilogram
mg/kg = Milligrams per kilogram
( ) = Number in parentheses is laboratory method detection limit (MDL)
ND = None detected above MDL
--- = Not analyzed

Table 2
Soil Analytical Results - Organic Analyses
Northern Section (February 1988)

Sample ID	CHI-1/88	CHI-2/88	CHI-3/88	CHI-4/88	CHI-5/88	CHI-6/88	CHI-7/88	CHI-8/88
Sample Depth (ft)	2-4	4-6	6-8	2-4	2-4	2-4	0-2	5-7
VOCs, ug/kg								
Acetone	ND(40)	ND(40)	150	ND(40)	ND(40)	ND(40)	ND(40)	ND(40)
Benzene	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
Toluene	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
Ethylbenzene	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
Xylenes	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	580	ND(10)	ND(10)
1,1-Dichloroethane	ND(10)	ND(10)	200	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
Tetrachloroethene	TR(10)	TR(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)	ND(10)
1,1,1-Trichloroethane	30	20	13	ND(10)	ND(10)	ND(10)	ND(10)	20
Trichloroethene	ND(10)	ND(10)	ND(10)	ND(10)	14	ND(10)	ND(10)	ND(10)
BNAs*, ug/kg								
bis(2-ethylhexyl)phthalate	2,500	ND(330)	ND(330)	ND(330)	ND(330)	ND(330)	ND(330)	ND(330)
Petroleum Hydrocarbons*, mg/kg	930	4,600	7,900	2,600	460	16,000	22	120
PCBs*, mg/kg								
Aroclor 1260	0.61	ND(1.0)	0.47	ND(0.1)	ND(0.1)	0.6	ND(0.1)	ND(1.0)
Sulfides*, mg/kg	12	15	22	23	32	26	22	21
pH	5.7	5.6	6.4	6.3	5.7	6.0	5.2	5.1

Notes:
VOCs = Volatile Organic Compounds
BNAs = Base/Neutral and Acid Extractible Semi-Volatile Organic Compounds
PCBs = Ploychlorinated biphenyl compounds
ug/kg = Micrograms per kilogram
mg/kg = Milligrams per kilogram
( ) = Number in parentheses is laboratory method detection limit (MDL)
ND = None detected above MDL
--- = Not analyzed
TR = Compound detected but below MDL
* = Sample composited from approximately 0-10 feet

Table 3
Soil Analytical Results - Inorganic Analyses
Northern Section (December 1987)

Sample ID	CHI-1/87	CHI-2/87	CHI-3/87	CHI-4/87	CHI-5/87	CHI-6/87	CHI-7/87	CHI-8/87	CHI-9/87
Sample Depth (ft)	0-8	0-10	0-10	0-8	0-8	0-10	0-8	0-8	0-8
13 Metals, mg/kg									
Antimony	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (9)	ND (10)	ND (9)	ND (10)
Arsenic	2.83	1.85	2.69	2.26	2.35	1.96	3.32	1.13	2.9
Barium	30	30	30	20	50	---	---	---	---
Beryllium	0.149	0.196	0.207	0.319	0.29	0.09	0.11	0.11	0.14
Cadmium	0.75	ND (.9)	ND (1.0)	2.1	2.9	ND (.9)	ND (1.1)	ND (1.1)	ND (1.4)
Chromium	10	11	16	12	15	10	12	12	13
Copper	13	15	29	27	27	16	16	16	19
Total Cyanide	ND (.49)	ND (.48)	ND (.47)	ND (.44)	ND (.45)	ND (.42)	ND (.49)	ND (.53)	ND (.65)
Lead	10	70	40	400	200	60	70	70	40
Mercury	0.084	ND (0.08)	ND (.07)	0.073	0.44	0.17	0.09	ND (.09)	0.14
Nickel	6.0	7.8	10	7.4	9.7	7.4	7.9	9	12
Selenium	ND (.1)	ND (.06)	1.24	ND (.1)	ND (.1)	1.4	1.8	1.4	1.9
Silver	ND (.4)	ND (.5)	ND (.5)	ND (.6)	ND (.6)	ND (.4)	ND (.5)	ND (.5)	ND (.5)
Thallium	ND (10)	ND (20)	20	ND (20)	ND (20)	ND (20)	ND (20)	ND (20)	ND (30)
Zinc	29	120	88	30	69	43	49	39	42

Notes:
( ) Number in parentheses is laboratory method detection limit (MDL)
mg/kg = Milligrams per kilogram
ND = below MDL
--- = Not Tested

Table 4
Soil Analytical Results - Inorganic Analyses
Northern Section (February 1988)

Sample ID	CHI-1/88	CHI-2/88	CHI-3/88	CHI-4/88	CHI-5/88	CHI-6/88	CHI-7/88	CHI-8/88
Sample Depth (ft)	0-8	0-10	0-10	0-8	0-8	0-10	0-8	0-8
VOCs ug/kg								
Antimony (10)	ND (7)	ND (10)	ND (10)	ND (9)	ND (7)	ND (9)	ND (9)	ND (9)
Arsenic	2.14	2.12	2.12	2.26	2.13	2.37	3.22	2.09
Barium	ND (20)	30	20	ND (20)	30	50	20	30
Beryllium	0.09	0.19	0.19	0.24	0.25	0.36	0.36	0.21
Cadmium	1.9	0.98	0.94	1.2	1.9	11	1.8	1.1
Chromium	10	13	12	66	22	74	37	9.5
Copper	19	14	16	15	20	63	18	14
Total Cyanide	ND (.78)	ND (.78)	ND (.76)	ND (.86)	ND (.72)	ND (.84)	ND (.77)	ND (.89)
Lead	30	50	70	60	60	100	20	40
Mercury	ND (.06)	ND (.06)	ND (.06)	ND (.06)	ND (.07)	ND (.07)	ND (.07)	ND (.07)
Nickel	5.6	6.9	4.7	11	10	11	10	3.2
Selenium	ND (.1)	ND (.08)	ND (.09)	ND (.11)	ND (.09)	16	ND (.08)	0.16
Silver	0.41	0.52	0.46	ND(0.47)	ND (.5)	ND (.41)	ND (.33)	ND (.52)
Thallium	ND (20)	ND (20)	ND (20)	ND (20)	10	20	ND (20)	20
Zinc	23	51	39	23	40	60	25	23
Hexavalent Chromium	0.7	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	1.5	0.5

Notes:
( ) Number in parentheses is laboratory method detection limit (MDL)
mg/kg = Milligrams per kilogram
ND = below MDL
--- = Not Tested

Table 5
Soil Analytical Results - Organic Analyses
Central Section (July 1988)

Sample ID	B-1	B-2		B-3	B-4	B-5			B-6		B-7	
Sample Depth (ft)	0-4 & 14-16	0-8	8-16	0-13	0-10	0-7	7-10	13-15	7-11	14-20	4-10	12-17
VOCs, ug/kg												
Benzene	TR (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	TR (10)	ND (10)	13	ND (10)	31	ND (10)
Toluene	95	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	32	ND (10)	90	ND (10)	35	ND (10)
Ethylbenzene	29	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	TR (10)	ND (10)	36	ND (10)	ND (10)	ND (10)
Xylene	210	ND (10)	ND (10)	13	ND (10)	ND (10)	58	TR (10)	230	ND (10)	16	ND (10)
Trichloroethene	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	TR (10)	ND (10)
Acetone	55	ND (10)	ND (10)	ND (40)	ND (40)	ND (40)	ND (40)	ND (40)	93	ND (40)	110	ND (40)
MTBE	24	ND (20)	ND (20)	ND (20)	ND (20)	ND (20)	ND (20)	ND (20)	ND (20)	ND (20)	ND (20)	ND (20)
trans-1,2-Dichloroethene	ND (10)	ND (10)	ND (10)	40	ND (10)	ND (10)	120	ND (10)	290	ND (10)	TR (10)	ND (10)
Petroleum Hydrocarbons, mg/kg	3,700	230	870	5,700	150	570	160	400	72,000	56	6,100	450
PCBs, mg/kg												
Aroclor 1242	ND (0.1)	ND (0.1)	ND (0.1)	0.2	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Sulfides, ug/kg	---	---	---	---	---	---	---	---	49	15	20	6.9

Table 5
Soil Analytical Results - Organic Analyses
Central Section (July 1988)
(Continued)

Sample ID	B-8				B-9		B-10			B-11		B-12		
Depth (ft)	0-6	7-8	8-12	12-18	6-10	10-16	4-6	6-10	10-14	6-14	15-22	4-8	8-12	14-16&18-20
VOCs, ug/kg														
Benzene	ND (10)	TR (10)	TR (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	TR (10)	ND (10)	ND (10)	ND (10)	ND (10)
Toluene	ND (10)	54	210	TR (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	43	ND (10)	ND (10)	ND (10)	ND (10)
Ethylbenzene	ND (10)	ND (10)	150	TR (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	56	ND (10)	ND (10)	ND (10)	ND (10)
Xylene	ND (10)	73	790	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	180	ND (10)	ND (10)	ND (10)	ND (10)
Trichloroethene	ND (10)	TR (10)	ND (10)	ND (10)	TR (10)	ND (10)	ND (10)	ND (10)	ND (10)	20	ND (10)	ND (10)	ND (10)	ND (10)
Acetone	ND (40)	160	ND (40)	ND (40)	ND (40)	ND (40)	ND (40)	70	ND (40)	85	ND (40)	ND (40)	ND (40)	ND (40)
MTBE	ND (20)	ND (20)	ND (20)	ND (20)	ND (20)	ND (20)	ND (20)	ND (20)	ND (20)	ND (20)	ND (20)	ND (20)	ND (20)	ND (20)
trans-1,2-Dichloroethene	ND (10)	210	120	ND (10)	13	ND (10)	ND (10)	ND (10)	ND (10)	43	ND (10)	ND (10)	ND (10)	ND (10)
Petroleum Hydrocarbons, mg/kg	110	21,000	7,700	1,600	6,000	44	1,600	5,900	770	10,000	160	250	55	17
PCBs, mg/kg														
Aroclor 1242	ND (0.1)	ND (1)	ND (0.1)	ND (0.1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Sulfides, mg/kg	13	31	14	11	13	12	11	20	30	15	17	7	3	3

Notes:
VOCs = Volatile Organic Compounds
PCBs = Polychlorinated biphenyl compounds
ug/kg = Micrograms per kilogram
mg/kg = Milligrams per kilogram
ND = Below MDL
( ) = Number in parentheses is laboratory method detection limit (MDL)

Table 6
Soil Analytical Results - Semi-Volatile Organic Analyses
Central Section (July 1988)

Sample ID	B-1	B-2		B-3	B-4	B-5			B-6		B-7	
Depth (ft)	0-10-14-16	0-8	8-16	0-13	0-10	0-7	7-10	13-15	7-11	14-20	4-10	12-17
BNA, ug/kg												
Naphthalene	1,400	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	800	ND (330)	ND (3,300)	ND (330)	6,900	390
2-Methylnaphthalene	2,300	ND (330)	ND (330)	ND (330)	ND (330	ND (330)	760	ND (330)	ND (3,300)	ND (330)	3,500	ND (330)
Fluorene	410	ND (330)	ND (330)	ND (330)	ND (330)	600	ND (330)	ND (330)	ND (3,300)	ND (330)	12,000	ND (330)
Phenanthrene	2,000	2,500	ND (330)	700	360	5,700	ND (330)	ND (330)	ND (3,300)	ND (330)	50,000	720
Anthracene	470	ND (330)	ND (330)	ND (330)	ND (330)	1,600	ND (330)	ND (330)	ND (3,300)	ND (330)	18,000	TR (330)
Fluoranthene	2,200	3,300	ND (330)	1,700	590	10,000	2,000	ND (330)	ND (3,300)	ND (330)	50,000	790
Pyrene	3,700	3,500	ND (330)	2,000	940	7,100	1,700	ND (330)	ND (3,300)	ND (330)	87,000	460
Chrysene	1,300	1,600	ND (330)	770	520	4,900	660	ND (330)	ND (3,300)	ND (330)	24,000	ND (330)
Benzo(b) Fluoranthene	1,900	2,400	ND (330)	1,000	920	5,900	ND (330)	ND (330)	ND (3,300)	ND (330)	27,000	TR (330)
Benzo(a) Pyrene	1,100	1,200	ND (330)	640	480	3,700	ND (330)	ND (330)	ND (3,300)	ND (330)	31,000	ND (330)
Indeno(1,2,3-cd) Pyrene	ND (330)	520	ND (330)	ND (330)	ND (330)	3,000	ND (330)	ND (330)	ND (3,300)	ND (330)	12,000	ND (330)
Benzo (g,h,i) Perylene	ND (330)	520	ND (330)	ND (330)	380	3,100	ND (330)	ND (330)	ND (3,300)	ND (330)	13,000	ND (330)
Acenaphthene	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (3,300)	ND (330)	3,500	ND (330)
Dibenz(a,h)Anthracene	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	1,800	ND (330)	ND (330)	ND (3,300)	ND (330)	TR (3,300)	ND (330)
Acenaphthylene	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	380	ND (330)	ND (330)	ND (3,300)	ND (330)	9,800	ND (330)
Dibenzofuran	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (3,300)	ND (330)	9,000	ND (330)
Benzo(a) Anthracene	1,200	1,500	ND (330)	670	940	5,200	600	ND (330)	ND (3,300)	ND (330)	27,000	ND (330)
bis(2-Ethylhexyl)Phthalate	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (3,300)	ND (330)	ND (3,300)	ND (330)
Dimethylphthalate	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (3,300)	ND (330)	ND (3,300)	ND (330)

Table 6
Soil Analytical Results - Semi-Volatile Organic Analyses
Central Section (July 1988)
(Continued)

Sample ID	B-8				B-9		B-10			B-11		B-12		
Depth (ft)	0-6	7-8	8-12	12-18	6-10	10-16	4-6	6-10	10-14	6-14	15-22	4-8	8-12	14-16&18-20
BNA, ug/kg														
Naphthalene	ND (330)	ND (3,300)	390	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	2,600	ND (330)	TR (330)	TR (330)	ND (330)
2-Methylnaphthalene	ND (330)	ND (3,300)	2,200	TR (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	4,600	ND (330)	ND (330)	ND (330)	ND (330)
Fluorene	TR (330)	ND (3,300)	380	TR (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	3,500	ND (330)	TR (330)	TR (330)	ND (330)
Phenanthrene	2,800	ND (3,300)	700	ND (330)	ND (330)	ND (330)	1,200	ND (330)	ND (330)	7,300	ND (330)	5,900	1,100	TR (330)
Anthracene	785	ND (3,300)	ND (330)	TR (330)	ND (330)	ND (330)	340	ND (330)	ND (330)	910	ND (330)	1,900	TR (330)	TR (330)
Fluoranthene	5,200	ND (3,300)	2,100	ND (330)	ND (330)	ND (330)	1,600	ND (330)	480	5,900	490	9,600	1,600	300
Pyrene	3,000	ND (3,300)	880	464	TR (330)	ND (330)	2,200	TR (330)	500	5,300	TR (330)	5,200	920	TR (330)
Chrysene	2,200	ND (3,300)	360	168	ND (330)	ND (330)	1,200	ND (330)	ND (330)	1,700	ND (330)	4,900	640	TR (330)
Benzo(b) Fluoranthene	5,400	ND (3,300)	ND (330)	ND (330)	ND (330)	ND (330)	2,500	ND (330)	ND (330)	340	ND (330)	5,200	490	TR (330)
Benzo(a) Pyrene	2,000	ND (3,300)	ND (330)	TR (330)	ND (330)	ND (330)	980	ND (330)	ND (330)	480	ND (330)	5,500	650	TR (330)
Indeno(1,2,3-cd) Pyrene	1,300	ND (3,300)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND	ND (330)	2,300	TR (330)	ND (330)
Benzo (g,h,i) Perylene	1,500	ND (3,300)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND	ND (330)	2,100	TR (330)	ND (330)
Acenaphthene	ND (330)	ND (3,300)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	1,400	ND (330)	TR (330)	TR (330)	ND (330)
Dibenz(a,h)Anthracene	340	ND (3,300)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND	ND (330)	TR (330)	TR (330)	ND (330)
Acenaphthylene	TR (330)	ND (3,300)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	480	ND (330)	1,000	TR (330)	ND (330)
Dibenzofuran	ND (330)	ND (3,300)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND	ND (330)	TR (330)	TR (330)	ND (330)
Benzo(a) Anthracene	2,200	ND (3,300)	ND (330)	ND (330)	ND (330)	ND (330)	1,000	ND (330)	430	960	ND (330)	4,900	660	TR (330)
bis(2-Ethylhexyl)Phthalate	ND (330)	ND (3,300)	ND (330)	401	TR (330)	ND (330)	380	TR (330)	ND (330)	ND	ND (330)	33,000	720	320
Dimethylphthalate	ND (330)	ND (3,300)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND (330)	ND	1,200	ND (330)	ND (330)	ND (330)

Notes:

BNAs = Base/Neutral and Acid Extractible Semi-Volatile Organic Compounds

( ) = Number in parentheses is laboratory method detection limit (MDL)

MDL = Laboratory method detection level

ND = Below MDL

TR = Trace

Table 7
Soil Analytical Results - Inorganic Analyses
Central Section (July 1988)

Sample ID	B-1	B-2		B-3	B-4	B-5			B-6		B-7	
Depth (ft)	0-4 & 14-16	0-8	8-16	0-13	0-10	0-7	7-10	13-15	7-11	14-20	4-10	12-17
Total Metals, mg/kg												
Antimony	190	ND (6)	ND (4)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	4	ND (4)	ND (6)	5
Arsenic	2.85	4.91	2.11	3.61	4.65	7.28	2.76	1.39	2.28	1.25	5.44	2.69
Barium	100	60	40	100	50	80	110	70	980	30	100	50
Beryllium	ND (.04)	ND (.06)	ND (.04)	ND (.05)	ND (.05)	0.17	ND (.05)	ND (.04)	0.08	0.043	0.17	0.08
Cadmium	3.6	3.6	2.6	3	2.5	3.5	2.7	3.3	4.8	1.7	4.6	2.9
Chromium	20	23	15	17	18	21	29	21	18	8.1	36	19
Copper	38	26	27	33	32	27	19	43	37	14	51	36
Lead	1,500	120	10	340	130	60	260	40	6,500	7	320	30
Mercury	0.104	0.09	ND (.06)	0.25	0.44	0.09	ND (.07)	ND (0.06)	0.103	ND (.06)	0.08	ND (.07)
Nickel	17	19	12	15	15	18	14	17	12	8.1	30	15
Selenium	ND (.132)	ND (.16)	ND (.14)	ND (.15)	ND (.15)	ND (.14)	ND (.14)	ND (.14)	ND (.124)	ND (.12)	ND (.13)	ND (.11)
Silver	ND (.89)	ND (1.1)	ND (.9)	ND (.9)	ND (1.1)	ND (.8)	ND (.8)	ND (.7)	ND (.95)	ND (.95)	ND (1.1)	1.5
Thallium	20	20	ND (10)	10	ND (10)	20	ND (20)	20	ND (10)	ND (10)	ND (10)	ND (10)
Zinc	89	58	36	66	80	71	53	52	210	22	99	36
EP Toxicity, mg/kg												
Cadmium	0.2	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
Chromium	0.47	0.43	0.2	ND (0.2)	ND (0.2)	0.19	0.24	0.02	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Barium	0.2	0.2	0.1	0.8	0.3	0.2	0.3	ND (0.1)	1.0	ND (0.1)	0.3	ND (0.1)
Lead	ND (0.1)	ND (0.1)	ND (0.1)	0.1	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	1.0	ND (0.1)	ND (0.1)	ND (0.1)
Mercury	ND (.0002)	ND (.0002)	ND (.0002)	ND (.0002)	ND (.0002)	ND (.0002)	ND (.0002)	ND (.0002)	ND (.0002)	ND (.0002)	ND (.0002)	0.0002

Table 7
Soil Analyisis Results - Inorganic Results
Central Section (July 1988)
(Continued)

Sample ID	B-8				B-9		B-10			B-11		B-12		
Depth (ft)	0-6	7-8	8-12	12-18	6-10	10-16	4-6	6-10	10-14	6-14	15-22	4-8	8-12	14-16&18-20
Total Metals, mg/kg														
Antimony	5	ND (4)	5	ND (4)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (4)	ND (4)	ND (5)	ND (4)	ND (4)
Arsenic	5.1	4.77	1.43	1.81	1.83	0.77	7.73	2.95	1.4	1.8	1.6	6.2	1.25	1.42
Barium	60	170	50	40	70	40	50	360	60	50	50	70	30	50
Beryllium	0.04	0.04	0.05	0.05	ND (.05)	ND (.05)	0.05	ND (.05)	ND (.05)	ND (.05)	ND	ND (.04)	ND (.05)	ND (.041)
Cadmium	3.3	3	2.9	2.8	3.3	2.9	2.2	3.4	3.2	1.9	3	2.9	2.4	2.9
Chromium	24	18	21	17	15	17	16	29	19	17	16	18	11	23
Copper	24	20	37	29	32	32	32	39	36	26	41	27	24	37
Lead	50	970	20	9	100	9	280	2,500	20	199	10	30	20	10
Mercury	0.1284	ND (.07)	ND (.07)	ND (.07)	ND (.07)	ND (.07)	0.33	ND (.07)	ND (.07)	ND (.06)	ND (.07)	ND (.06)	ND (.07)	ND (.07)
Nickel	17	12	16	14	18	14	12	14	16	12	14	14	9.6	16
Selenium	ND (.13)	ND (.14)	ND (.12)	ND (.14)	ND (.16)	ND (.15)	ND (.14)	ND (.16)	ND (.17)	ND (.11)	ND (.14)	ND (.14)	ND (.15)	ND (.14)
Silver	ND (.92)	ND (.9)	ND (.86)	ND (.9)	ND (1.1)	ND (.99)	ND (1.1)	ND (1.1)	ND (.9)	ND (1.0)	0.9	ND (.9)	ND (.76	ND (.97)
Thallium	10	10	10	20	20	20	ND (20)	30	30	20	20	ND (10)	ND (10)	ND (10)
Zinc	68	96	46	33	46	36	120	120	41	35	40	70	33	37
EP Toxicity, mg/kg														
Cadmium	ND (.01)	ND (.01)	ND (.01)	ND (.01)	ND (.01)	ND (.01)	ND (.01)	ND (.01)	ND (.01)	ND (.01)	ND (.01)	ND (.01)	ND (.01)	ND (.01)
Chromium	ND (.02)	ND (.02)	ND (.02)	0.25	ND (.02)	0.46	0.05	0.09	0.06	ND (.02)	0.13	ND (.02)	ND (.02)	ND (.02)
Barium	0.3	0.6	ND (0.1)	ND (0.1)	0.4	ND (0.1)	0.2	0.7	ND (0.1)	ND (0.1)	ND (0.1)	0.2	ND (0.1)	ND (0.1)
Lead	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	1	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Mercury	ND (.0002)	ND (.0002)	ND (.0002)	ND (.0002)	0.0004	ND (.0002)	ND (.0002)	ND (.0002)	ND (.0002)	ND (.0002)	ND (.0002)	ND (.0002)	ND (.0002)	ND (.0002)

Notes:

( ) Number in parentheses is laboratory method detection limit (MDL)

mg/kg = Milligrams per kilogram

ND = below MDL

Table 8
Soil Analytical Results - Organic Analyses
Central Section (February 1989)

Sample ID	Sample Depth (ft)	Methylene Chloride (ug/kg)	Toluene (ug/kg)	Xylenes (ug/kg)	Petroleum Hydrocarbons (mg/kg)	PCBs (mg/kg)
W-89-S1	0-2	ND (5)	ND (5)	ND (5)	250	---
	2-4	---	---	---	360	---
	6-8	ND (10)	ND (10)	ND (10)	370	ND (.1)
	8-10	---	---	---	18,000	ND (.1)
	10-12	ND (5)	10	ND (5)	85	---
W-89-S3	0-2	18	ND (10)	ND (10)	380	---
	4-6	---	---	---	62	---
	6-8	ND (10)	ND (10)	ND (10)	ND (10)	---
	8-10	---	---	---	ND (10)	---
	10-12	---	---	---	ND (10)	---
W-89-S4	0-2	ND (5)	ND (5)	ND (5)	19	---
	4-6	---	---	---	1,500	---
	6-8	ND (10)	ND (10)	TR (10)	280	---
	8-10	ND (10)	ND (10)	ND (10)	63	0.2*
	15-17	ND (5)	ND (5)	ND (5)	---	---
W-89-S14	0-2	TR (10)	ND (10)	ND (10)	67	---
	4-6	---	---	---	4,300	ND (1)
	6-8	---	---	---	6,500	---
	8-10	---	---	---	87	---

Table 8
Soil Analytical Results - Organic Analyses
Central Section (February 1989)
(continued)

Sample ID	Sample Depth (ft)	Methylene Chloride (ug/kg)	Toluene (ug/kg)	Xylenes (ug/kg)	Petroleum Hydrocarbons (mg/kg)	PCBs (mg/kg)
W-89-S15	0-2	ND (10)	ND (10)	ND (10)	200	---
	4-6	---	---	---	37	---
	6-8	---	---	---	13	---
	8-10	ND (10)	ND (10)	ND (10)	ND (10)	---
	15-17	---	---	---	13	---
W-89-S16	0-2	TR (10)	ND (10)	ND (10)	13	---
	4-6	---	---	---	ND (10)	---
	6-8	ND (10)	ND (10)	ND (10)	ND (10)	---
	8-10	---	---	---	14	---
	10-12	---	---	---	ND (10)	---
W-89-S17	0-2	12	ND (10)	ND (10)	350	---
	4-6	---	---	---	510	---
	6-8	---	---	TR (10)	3,600	ND (1.0)
	8-10	---	---	---	14,000	---
W-89-S18	0-2	ND (10)	ND (10)	ND (10)	31	---
	4-6	---	ND (2)	ND (2)	140	---
	6-8	---	---	---	20,000	ND (1.0)
	8-10	---	---	---	5,100	---

Notes:
ug/kg = Micrograms per kilogram
mg/kg = Milligrams per kilogram
ND = None detected above MDL
( ) = Number in parentheses is laboratory method detection limit (MDL)
PCBs = Polychlorinated biphenyl compounds (*Aroclor 1254)
--- = Not analyzed

Table 9
Soil Analytical Results - Semi-Volatile Organic Analyses
Central Section (February 1989)

Compound	W-89-S17 6 - 8 feet	W-809-S4 6 - 8 feet	W-89-S4 8 - 10 feet	W-89-S18 6 - 8 feet
BNAs, ug/kg				
Phenanthrene	TR (330)	ND (330)	ND (330)	ND (1,600)
Fluoranthene	480	ND (330)	ND (330)	ND (1,600)
Pyrene	910	ND (330)	ND (330)	ND (1,600)
Benzo(a)Anthracene	TR (330)	ND (330)	ND (330)	ND (1,600)
Chrysene	TR (330)	ND (330)	ND (330)	ND (1,600)
Benzo(b)Fluoranthene	430	ND (330)	ND (330)	ND (1,600)
Benzo(a)Pyrene	TR (330)	ND (330)	ND (330)	ND (1,600)
Indeno(1,2,3-cd)Pyrene	1,300	ND (330)	ND (330)	ND (1,600)
Benzo(g,h,i)Perylene	350	ND (330)	ND (330)	ND (1,600)

Notes:
ug/kg = Micrograms per kilogram
BNAs = Base/Neutral and Acid Extractible Semi-Volatile Organic Compounds

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February 1, 1994

File Copy

Mr. John A. Carrigan
Department of Environmental Protection
Hazardous Waste Regulatory Program
1 Winter Street
Boston, Massachusetts 02108

Re: Murphy's Waste Oil Service, Inc.
Hydrogeologic Characterization Report

Dear Mr. Carrigan:

Enclosed please find two (2) copies of a Hydrogeologic Characterization Report for the Murphy's Waste Oil Service, Inc. site. This report is submitted pursuant to Section 10 of the facility's RCRA Part B Permit.

The enclosed report presents a characterization of the site based upon a document review, conversations with certain individuals who are knowledgeable of the site's history, and records of past work performed on the site by Clean Harbors. As you have been previously advised, the Wells G&H Superfund Site PRP Group is conducting an investigation of their site and surrounding properties, including the Murphy's site. It had been anticipated that we would have received some results of their investigation which would have had a bearing on the enclosed report. However, according to the PRP Group's consultant, its report has been delayed and will not be available until the spring. As documented in the "Recommendations" section of the enclosed report, we propose to review the PRP Group's report and, based upon its content, prepare a Scope of Work to obtain any additional data necessary to complete the hydrogeologic characterization. Based upon the presently scheduled release date for the PRP Group's report, we anticipate being able to submit the Scope of Work to DEP by June 30th.

If you have any questions, please do not hesitate to contact me. Any questions regarding the technical content of the enclosed report should be directed to Jay McCreery at (617) 849-1800, extension 1399.

Very truly yours,

Jules B. Selden
Attorney

Enclosures

cc: Charles J. McCreery (enc)
Stephen Applebaum (enc)
Dana Simpson
Norman Nelhuebel
Joan Murphy (enc)